RAILWAY ENGINEERING

AND MAINTENANCE OF WAY

Vol. IV MARCH, 1908 No. 3

Railway Engineering
and Maintenance of Way

PUBLISHED BY
CRANDALL PUBLISHING COMPANY

BRUCE V. CRANDALL, President WARREN EDWARDS, Vice-President C. C. ZIMMERMAN, Secretary
MAHAM H. HAIG, Managing Editor NORMAN F. REHM, Editor

OFFICE OF PUBLICATION: Security Building, Cor. Madison St. and Fifth Ave., CHICAGO Telephone Main 3185

Entered as Second-Class Matter April 13. 1905, at the Post Office at Chicago, Illinois, Under Act of March 3, 1879.

¶ A series of articles on track and roadbed standards has begun in RAILWAY ENGINEERING AND MAINTENANCE OF WAY. The object is to publish in clear, concise manner, an illustrated review of present practice in this department of railroad construction.

¶ Among the subjects which will receive careful attention will be:

¶ Road Bed Sections, Rail Sections, Tie-Plates, Switches, Turnouts, Crossovers, Frogs, Switch Stands, Crossings, Cattle Guards, Fences, Foot-Guards, Guard Rails and Rail Joints.

¶ In designing or revising track standards a comparison of the practice on important roads is of assistance. To afford an easy means of comparison, tables of main dimensions are compiled when possible. Tabulated data contains more information in a given space than any other, and in many cases it is by far the more valuable. Descriptions which accompany these tables cover points which are usually of minor importance but still essential to a thorough understanding.

¶ It is our aim to make this of timely and lasting value and information to every track official. We have had the assistance and co-operation of many of the leading engineers in obtaining this data. The subjects treated will be dealt with in a manner best calculated to benefit those whose work lies in this field. The articles are written in the clear, fluent style that makes possible complete comprehension of the subject, and illustrated from drawings that leave no doubt as to details.

¶ The series will be valuable as reference data, and the whole bound into one volume will be kept and referred to as questions to be discussed and problems to be solved arise hereafter.

¶ We commend these articles to you for careful consideration, believing they will in part, and as a whole, be of more benefit and real interest to you than anything that has recently appeared in print on this all-important and vital subject of the science of engineering.

CLASSIFIED INDEX OF ADVERTISERS

Anti Rail Creeper.
Adreon & Co., St. Louis.
Asbestos Products. All kinds.
Franklin Mfg. Co., Franklin, Pa.
Asbestos Roofing Slates.
Franklin Mfg. Co., Franklin, Pa.
Asbestos Sheathing.
Franklin Mfg. Co., Franklin, Pa.
Asphalt.
Standard Asphalt & Rubber Co., Chicago.
Asphalt Roofing.
Stowell Mfg. Co., Jersey City, N. J.
Asphalt Roofing Paints.
Carey Mfg. Co., The Philip, Jersey City, N. J.
Ballast Cars.
Rodger Ballast Car Co., Chicago.
Ballast Placing Device.
Adreon & Co., St. Louis.
Rodger Ballast Car Co., Chicago.
Walters & Okell, Ft. Madison, Ia.
Ballast Unloaders.
Rodger Ballast Car Co., Chicago.
Battery Chutes.
Buda Foundry & Mfg. Co., Chicago.
Bells
Schwarze Electric Co., Adrian, Mich.
Bell Ringers.
Adreon & Co., St. Louis.
Blocks and Tackles.
Patterson Co., W. W., Pittsburg, Pa.
Blue Print Papers.
Kolesch & Co., New York.
Blue Printing Machines.
Kolesch & Co., New York.
Boarding Camps.
Railway Boarding Camp & Catering Co., Moline, Ill.
Bolts and Nuts.
Adreon & Co., St. Louis, Mo.
Railway Supply Co., St. Louis.
Books.
Audel & Co., Theo., New York.
Wiley, John & Sons, New York.
Bridge Paint.
Acme White Lead & Color Co., Detroit, Mich.
Carey Mfg. Co., The Philip, Cincinnati, O.
Detroit Graphite Mfg. Co., Detroit, Mich.
Dixon, Joseph, Crucible Co., Jersey City.
Sherwin-Williams Co., Cleveland, O.
Stowell Mfg. Co., Jersey City, N. J.
Suydam Co., M. B., Pittsburg, Pa.
Wadsworth Howland Co., Chicago.
Bumping Posts.
Mechanical Mfg. Co., Chicago.
McCord & Co., Chicago.
Building Felts and Papers.
Franklin Mfg. Co., Franklin, Pa.
Cars.
Torbert, A. C. & Co., Chicago.
Cars Ballast.
Rodgers Ballast Car Co., Chicago.
Cars Dump.
Rodgers Ballast Car Co., Chicago.
Cars Rebuilt.
Atlantic Equipment Co., New York.
Hicks Car & Locomotive Works, Chicago.
Car Replacers.
Buda Foundry & Mfg. Co., Chicago.
Cars, Second Hand.
Atlantic Equipment Co., New York.
Cast Iron Pipe.
Yale, Julian L. & Co., Chicago.
Cattleguards.
Adreon & Co., St. Louis, Mo.
Buda Foundry & Mfg. Co., Chicago.
Johnson, The W. P. Co., Chicago.
Standard Cattle Guard Co., Birmingham, Ala.
Chains.
Adreon & Co., St. Louis, Mo.
Patterson Co., W. W., Pittsburg, Pa.
Chimney Cast Iron.
Dickinson, Paul, Chicago.
Coal and Ore Handling Machinery.
Rodgers Ballast Car Co., Chicago.
Cold Water Paints.
Carey Mfg. Co., The Philip, Cincinnati, O.
Computing Machines.
Kolesh & Co., New York.
Concrete Mixers.
Chicago Concrete Machinery Co., Chicago.
Conduits—Reinforced Concrete.
Reinforced Concrete Pipe Co., Jackson, Mich.
Contractors' Equipment and Supplies.
Adreon & Co., St. Louis.
Atlantic Equipment Co., New York.
Chicago Concrete Machinery Co., Chicago.
McKeown, H. J., Cincinnati, O.
Porter, H. K., Co., Pittsburg.
Railway Boarding Camp & Catering Co., Moline, Ill.
Railway Supply Co., St. Louis.
Rodgers Ballast Car Co., Chicago.
Contractors Light.
Wells Light Mfg. Co., New York.
Contractor's Locomotives.
Vulcan Iron Works, Wilkes-Barre, Pa.
Coupler and Parts.
Adreon & Co., St. Louis, Mo.
Crabs.
McKeown, H. J., Cincinnati, O.
Crossing Bells.
Schwarze Electric Co., Adrian, Mich.
Crossing Gates.
Buda Foundry & Mfg. Co., Chicago.
Crossing Signals.
Adreon & Co., St. Louis.
Crossing (See Frogs and Crossings).
McKeown, H. J., Cincinnati, O.
Culvert Pipe Clay.
Evens & Howard Fire Brick Co., St Louis, Mo.
Culvert Pipe—Reinforced Concrete.
Reinforced Concrete Pipe Co., Jackson, Mich.
Ditching and Excavating Machinery.
Atlantic Equipment Co., New York.
Doors, Steel Rolling.
Adreon & Co., St. Louis, Mo.
Draughting Room Supplies.
Kolesh & Co., New York.
Dredges.
Atlantic Equipment Co., New York.
Dump Cars.
Rodgers Ballast Car Co., Chicago.

CLASSIFIED INDEX OF ADVERTISERS
(CONTINUED)

Electric Crossing Bells.
Schwarze Electric Co., Adrian, Mich.
Engines, Gas and Gasoline.
Otto Gas Engine Works, Chicago.
Engines, Steam or Gasoline, for Concrete Mixers.
Chicago Concrete Machinery Co., Chicago.
Engines, Hoisting.
McKeown, H. J., Cincinnati, O.
Excavating Machinery.
Atlantic Equipment Co., New York.
Expanded Metal.
Merritt & Co., Philadelphia, Pa.
Extension Bells.
Schwarze Electric Co., Adrian, Mich.
Fire Proof Paint.
Detroit Graphite Mfg. Co., Detroit.
Forges, Portable.
Railway Supply Co., St. Louis.
Forgings.
Cleveland City Forge & Iron Co., Cleveland, O.
Frogs and Crossings.
Buda Foundry & Mfg. Co., Chicago.
Indianapolis Switch & Frog Co., Springfield, O.
Gas Engines.
Otto Gas Engine Works, Chicago.
Chicago Concrete Machinery Co., Chicago.
Gaskets.
McCord & Co., Chicago.
Railway Supply Co., St. Louis.
Gasoline Engines for Concrete Mixers.
Chicago Concrete Machinery Co., Chicago.
Gates, Railroad Crossing.
Buda Foundry & Mfg. Co., Chicago.
Graphite.
Detroit Graphite Mfg. Co., Detroit.
Dixon, Jos., Crucible Co., Jersey City, N. J.
Railway Supply Co., St. Louis.
Sherwin-Williams Co., Cleveland, O.
Graphite Paint.
Wadsworth-Howland Co., Chicago.
Hand Cars.
Buda Foundry & Mfg. Co., Chicago.
Railway Supply Co., St. Louis.
Hand Rail Paint.
Wadsworth-Howland Co., Chicago.
Hoisting Engines.
McKeown, H. J., Cincinnati, O.
Otto Gas Engine Works, Chicago.
Inspection Cars.
Buda Foundry & Mfg. Co., Chicago.
Railway Supply Co., St. Louis.
Instruments, Engineering and Surveying.
Hanna Mfg. Co., Troy, N. Y.
Kolesh & Co., New York.
Insulating Gums.
Standard Asphalt & Rubber Co., Chicago.
Jacks.
Buda Foundry & Mfg. Co., Chicago.
Dudgeon, Richard, New York.
Duff Mfg. Co., Allegheny, Pa.
Henderer's, A. L., Sons, Wilmington, Del.
Railway Supply Co., St. Louis.
Watson-Stillman Co., New York.
Jacks, Hydraulic.
Dudgeon, Richard, New York.
Henderer's, A. L., Sons, Wilmington, Del.
Railway Supply Co., St. Louis.
Watson-Stillman Co., New York.

Journal Box Brasses.
Adreon & Co., St. Louis, Mo.
Journal Box Lids.
Adreon & Co., St. Louis, Mo.
Journal Box Wedges.
Adreon & Co., St. Louis, Mo.
Lamps & Lanterns.
Adreon & Co., St. Louis, Mo.
Railway Supply Co., St. Louis.
Light, Locomotive (See Locomotive Contractors.)
Lights, Contractors.
Wells Light Mfg. Co., New York.
Railway Supply Co., St. Louis.
Lockers, Metal.
Merritt & Co., Philadelphia.
Locomotives.
Torbert, A. C. & Co., Chicago.
Vulvan Iron Works, Wilkes-Barre, Pa.
Locomotives, Compressed Air.
Atlantic Equipment Co., New York.
Porter, H. K. Co., Pittsburg, Pa.
Locomotives, Contractors'.
Atlantic Equipment Co., New York.
Hicks, F. M., & Co., Chicago.
Porter, H. K., Co., Pittsburg.
Locomotives, Electric.
Atlantic Equipment Co., New York.
Porter & Co., H. K., Pittsburg, Pa.
Locomotive Headlights.
Adreon & Co., St. Louis, Mo.
Locomotives, Mine.
Atlantic Equipment Co., New York.
Porter, H. K., Co., Pittsburg.
Locomotives, Rebuilt.
Atlantic Equipment Co., New York.
Hicks Locomotive & Car Works, Chicago.
Locomotives, Second Hand.
Atlantic Equipment Co., New York.
Hicks Locomotive & Car Works, Chicago.
Logging Cars.
Buda Foundry & Mfg. Co., Chicago.
Railway Supply Co., St. Louis.
Lubricants (Graphite).
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Mastics.
Standard Asphalt & Rubber Co., Chicago.
Measuring Tapes.
Hanna Mfg. Co., Troy, N. Y.
Kolesh & Co., New York.
Mineral Rubber.
Standard Asphalt & Rubber Co., Chicago.
Nut Locks.
American Lock Nut Co., Boston, Mass.
Railway Supply Co., St. Louis.
Spencer Otis Co., Chicago.
Oil Tanks.
Bowser, S. F., & Co., Ft. Wayne, Ind.
Paints.
Carey Mfg. Co., The Philip, Cincinnati, O.
Detroit Graphite Mfg. Co., Detroit.
Devoe, F. W., & Co., New York.
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Sherwin-Williams Co., Cleveland, O.
St. Louis Surfacer & Paint Co., St. Louis, Mo.
Wadsworth-Howland Co., Chicago.
Paint and Varnish Gums.
Standard Asphalt & Rubber Co., Chicago.
Paving Asphalt and Fillers.
Standard Asphalt & Rubber Co., Chicago.
Perforated Metal.
Adreon & Co., St. Louis, Mo.
Railway Supply Co., St. Louis.
Pile Driving Engines.
McKeown, H. J., Cincinnati, O.
Pipe, Cast Iron.
Yale, Julian L. & Co., Chicago.
Pipe Dip and Coatings.
Standard Asphalt & Rubber Co., Chicago.
Pipe Joint Paste.
Detroit Graphite Mfg. Co., Detroit.
Pneumatic Crossing Gates (See Gates Railroad Crossing.)
Pneumatic Gates.
Buda Foundry & Mfg. Co., Chicago.
Pumps.
Bowser, S. F., & Co., Ft. Wayne, Ind.
Pumps, Boiler Test.
Henderer's, A. L., Sons, Wilmington, Del.
Punches.
Henderer's, A. L., Sons, Wilmington, Del.
Push Cars.
Buda Foundry & Mfg. Co., Chicago.
Rail Benders.
Adreon & Co., St. Louis.
Buda Foundry & Mfg. Co., Chicago.
Spencer Otis Co., Chicago.
Rail Braces.
Adreon & Co., St. Louis.
Buda Foundry & Mfg. Co., Chicago.
Indianapolis Switch & Frog Co., Springfield, O.
Railway Supply Co., St. Louis.
Rail Drills.
Buda Foundry & Mfg. Co., Chicago.
Indianapolis Switch & Frog Co., Springfield, O.
McInnes Steel Co., Corry, Pa.
Railway Supply Co., St. Louis.
Rail Joints.
Buda Foundry & Mfg. Co., Chicago.
Snow, J. H., Indianapolis, Ind.
Rail Saw.
Adreon & Co., St. Louis.
Railroad Equipment and Supplies.
Adreon & Co., St. Louis.
Atlantic Equipment Co., New York.
Buda Foundry & Mfg. Co., Chicago.
Indianapolis Switch & Frog Co., Springfield, O.
Hicks Locomotive & Car Works, Chicago.
McCord & Co., Chicago.

CLASSIFIED INDEX OF ADVERTISERS (CONTINUED)

Rails (New.)
Atlantic Equipment Co., New York.
Rails (Second Hand.)
Atlantic Equipment Co., New York.
Hicks Locomotive & Car Works, Chicago.
Railroad Coatings.
Standard Asphalt & Rubber Co., Chicago.
Railway Equipment and Supplies.
Railway Supply Co., St. Louis.
Railways Supplies, General.
Adreon & Co., St. Louis.
Buda Foundry & Mfg. Co., Chicago.
Railway Supply Co., St. Louis.
Ratchet Wrenches.
Adreon & Co., St. Louis, Mo.
Replacers, Car, and Engines.
Adreon & Co., St. Louis, Mo.
Riveters.
Otto Gas Engine Works, Chicago.
Rolling Steel Doors and Shutters.
Adreon & Co., St. Louis, Mo.
Rolling Stock.
Atlantic Equipment Co., New York.
Hicks, F. M., & Co., Chicago.
Roof Paint.
Bird, F. W. & Son, East Walpole, Mass.
Carey Mfg. Co., The Philip, Cincinnati, O.
Stowell Mfg. Co., Jersey City, N. J.
Roofing.
Bird, F. W. & Son, E. Walpole, Mass.
Stowell Mfg. Co., Jersey City, N. J.
Roofing Materials.
Standard Asphalt & Rubber Co., Chicago
Roofing Materials, Asbestos.
Franklin Mfg. Co., Franklin, Pa.
Roofing Slates and Shingles, Asbestos.
Franklin Mfg. Co., Franklin, Pa.
Safety Gates.
Buda Foundry & Mfg. Co., Chicago.
Sand Driers.
Parkhurst & Wilkinson, Chicago.
Scales.
Buda Foundry & Mfg. Co., Chicago.
Second Hand Equipment.
Atlantic Equipment Co., New York.
Hicks Locomotive & Car Works, Chicago.
Sheathing, Asbestos.
Franklin Mfg. Co., Franklin, Pa.
Shovels.
Jackson Tool & Shovel Co., Montpelier, Ind.
Railway Supply Co., St. Louis.
Shutters, Rolling Steel.
Adreon & Co., St. Louis, Mo.
Columbus Steel Rolling Shutter Co., Columbus, O.
Signal Bells for Crossings.
Schwarze Electric Co., Adrian, Mich.
Signal Lamps.
Adreon & Co., St. Louis, Mo.
Railway Supply Co., St. Louis.
Signals.
Adreon & Co., St. Louis, Mo.
Slide Rules.
Kolesch & Co., New York.
Smoke Jacks.
Dickinson, Paul, Chicago.
Stand Pipes.
Adreon & Co., St. Louis, Mo.
Station Paint.
Wadsworth-Howland Co., Chicago.
Steam Shovels.
Atlantic Equipment Co., New York.
Torbert, A. C. & Co., Chicago.
Steel for Track Drills and Tools.
McInnes Steel Co., Corry, Pa.
Steel Ties.
Galt, Thomas A., Sterling, Ill.
Stock Guards.
Johnson Co., W. P., Chicago.
Standard Cattle Guard Co., Birmingham, Ala.
Stoves.
Buda Foundry & Mfg. Co., Chicago.
Structural Iron Paints.
Carey Mfg. Co., The Philip, Cincinnati, O.
St. Louis Surfacer & Paint Co., St. Louis.
Wadsworth-Howland Co., Chicago.
Surveying Instruments.
Hanna Mfg. Co., Troy, N. Y.
Kolesch & Co., New York.
Switch Indicator Bells.
Schwarze Electric Co., Adrian, Mich.
Switches and Switch Stands.
Buda Foundry & Mfg. Co., Chicago.
Indianapolis Switch & Frog Co., Springfield, O.
Tackle Blocks.
Patterson Co., W. W., Pittsburg, Pa.
Tanks and Tank Fixtures.
American Valve & Meter Co., Cincinnati.
Otto Gas Engine Works, Chicago.
Jackson Tool & Shovel Co., Montpelier, Ind.
Millers-Falls Co., New York.
Railway Supply Co., St. Louis.
Walters & Okell, Ft. Madison, Ia.
Tie Plates.
Adreon & Co., St. Louis, Mo.
Spencer Otis Co., Chicago.
Telephone Extension Bells.
Schwarze Electric Co., Adrian, Mich.
Ties, Steel.
Galt, Thomas A., Sterling, Ill.
Tool Steel.
McInnes Steel Co., Corry, Pa.
Track Drills.
Buda Foundry & Mfg. Co., Chicago.
Baldwin Steel Co., New York.
McInnes Steel Co., Corry, Pa.
Millers-Falls Co., New York.
Reed Co., Francis, Worcester, Mass.
Track Gauges and Level.
Buda Foundry & Mfg. Co., Chicago.
Railway Supply Co., St. Louis.
Track Jacks (See Jacks.)
Track Laying Machinery.
D. I. Holman Track Layer Co., Chicago.
Track Signs.
Adreon & Co., St. Louis.
Buda Foundry & Mfg. Co., Chicago.
Track Materials.
Indianapolis Switch & Frog Co., Springfield, O.
Track Tools.
Adreon & Co., St. Louis.
Buda Foundry & Mfg. Co., Chicago.
Turnbuckles.
Cleveland City Forge & Iron Co., Cleveland, O.
Valves.
American Valve & Meter Co., Cincinnati.
Varnishes.
Devoe, F. W., & Co., New York.
Velocipedes, Railway.
Buda Foundry & Mfg. Co., Chicago.
Railway Supply Co., St. Louis.
Vises.
Adreon & Co., St. Louis, Mo.
Dickinson, Paul, Chicago.
Water Columns.
American Valve & Meter Co., Cincinnati.
Water Proofing.
Standard Asphalt & Rubber Co., Chicago.
Water Softening Apparatus.
Kennicott Water Softener Co., Chicago.
Water Tanks.
Adreon & Co., St. Louis.
Railway Supply Co., St. Louis.
Wire Rope.
Railway Supply Co., St. Louis.
Wrecking Cars.
Buda Foundry & Mfg. Co., Chicago.
Wrecking Frogs.
Railway Supply Co., St. Louis.

RAILWAY ENGINEERING
and Maintenance of Way

Published by the
CRANDALL PUBLISHING COMPANY

BRUCE V. CRANDALL, President — WARREN EDWARDS, Vice-President
C. C. ZIMMERMAN, Secretary — MAHAM H. HAIG, Managing Editor
NORMAN F. REHM, Editor

Office of Publication: Security Building
Corner Madison St. and Fifth Ave.
CHICAGO
Telephone, Main 3185.

A Monthly Railway Journal

Devoted to the interests of railway engineering, maintenance of way, bridges and buildings.

Communications on any topic suitable to our columns are solicited.

Subscription price, $1.00 a year; to foreign countries, $1.50, free of postage. Single copies, 10 cents. Advertising rates given on application to the office, by mail or in person.

In remitting, make all checks payable to the Crandall Publishing Company.

Papers should reach subscribers by the tenth of the month at the latest. Kindly notify us at once of any delay or failure to receive any issue and another copy will be very gladly sent.

Entered as Second-Class Matter April 13, 1905, at the Post Office at Chicago, Illinois, Under the Act of Congress of March 3, 1879.

Vol. IV — Chicago, March, 1908 — No. 3

CONTENTS.

Co-operation

THE necessity of co-operation between engineer and yardmaster to the successful design of a railroad terminal or yard is generally recognized. The situation is similar to that which arises in the construction of a manufacturing plant. In the latter case the designing engineer has the general knowledge obtained from study of the operation of many plants, while the superintendent in charge of that particular plant understands the special requirements and particulars of the business for which the plant is to be erected.

The railroad engineer profits likewise by the yardmaster's experience. If he should lay out a yard without consulting the man in charge of operation, he is liable to design an inefficient as well as costly yard. The yardmaster's familiarity with existing conditions on his road almost makes his services indispensable when it comes to the enlargement of an old yard or the construction of a new one.

Again, in track work the roadmaster advises the changes to be made in case roadbed renewals are necessary or extensions of line are to be made. It is acknowledged that the roadmaster has the better opportunity to study out improvements in track construction on account of his constant association with such work and that his suggestions carry the weight of practical knowledge.

Co-operation is essential to successful design in cases similar to those cited above. Most engineers recognize that this is true and therefore consult the yardmaster, roadmaster or other official in direct charge of the work.

Rigid Frogs

RIGID frogs from No. 8 to and including No. 10 are generally used and are made 15 feet in length with few exceptions. Frogs below No. 8 decrease in length to about 8 feet, while those above No. 10 increase in length to about 30 feet.

The rigid frog is usually of the bolted type with wrought iron fillers between wing and point rails. The wing rails are riveted to a single plate, 5 feet in length, or to tie plates. Point rails are riveted together.

It is not necessary, however, to rivet wing rails to tie plates and occasionally it causes some inconvenience in placing the frog. Where a single plate is used, fillers between wing and point rails are sometimes omitted and the point rails are also riveted to the plate. The latter construction does not, however, render the frog as durable as a bolted frog.

At the throat of the frog it is customary to bolt wing rails through a cast iron filler. Between point rails, a heel riser is located and bolted to rails.

The width of flangeway is either 1¾ or 1⅞ inches. The majority of roads specify a 1¾-inch flangeway. The width of throat varies between 1¾ and 2½ inches, giving an average of about 2 inches. At the convention of the American Railway and Main-

tenance of Way Association to be held March 17, 18 and 19, the question of the width of flangeway and throat will probably be discussed.

The Bright Side of Railroading

THERE is a bright side to railroad work, as there is to any work in which a man puts his confidence, interest and enthusiasm. Sometimes the brighter features of the railway environment fail to make themselves evident at the moment. However, men will look back when in a reminiscent mood and find that experiences which, when they occurred, seemed rough and rugged, have features that call forth many pleasant recollections.

That railway life has a bright side, or even several bright sides, was well brought out by Mr. C. E. Lee, general superintendent of the Boston & Maine Railroad, in a clever and interesting paper entitled "The Bright Side of Railroading," recently presented before the New England Railroad Club. Mr. Lee explained that even in the awful tragedies of railroading there is some times a touch of comedy, and in the impractical suggestions for improving railway service made by well-meaning and friendly persons, there is often the source of much amusement. The railway supply man, he says, is a large and increasing factor to the bright side of railroading. With his cheery greeting and pleasant smile the supply man some times prevents the railway man from doing what he wants to do, yet he is equally potent in giving the railroader a pleasant excuse for postponing things that he does not want to do.

Split Switches

THE split switch in use on the majority of railroads is 15 feet in length for turnouts Nos. 7 to 12 inclusive, is less than 15 feet for turnouts Nos. 4, 5 and 6, and is greater for turnouts above No. 12. It has been recommended that 16½-foot switch points be used since rails of 33-foot length are supplied, but the 15-foot split switch is still the more common standard.

The elevation of switch rail above stock rail is usually made ¼ inch and it is effected by means of tie plates with pressed risers. The switch rail is about ⅝ inch below stock rail at point and reaches its greatest elevation above stock rail between 5 and 6 feet back of switch point. In most cases the switch rail falls to the elevation of stock rail at the heel of switch, the switch rail being bent and resting on risers of varying thickness. The switch rail may, however, retain the ¼-inch elevation to the heel of switch, the fall in elevation being in the lead rail beyond the heel of switch. In the latter case there is no vertical bend in the switch rail, which will, therefore, lie flat on the ties or riser plates, and the fall in elevation occurs in the lead rail which is fully spiked on both sides.

The elevation of switch rail above stock rail will be necessary as long as locomotive tires are allowed to become guttered. It is customary on many roads to limit the guttering to ¼-inch, chiefly because the wear on the rails would be excessive if the track included more than one weight or design of rail which often happens to be the case. Therefore to carry this "double flange" of ¼ inch over the stock rail, the switch rail is given a ¼-inch rise.

Tie rods of various designs are used. Some are adjustable and provide for insulation between rails. On 15-foot switch points two tie rods are sufficient.

In another column a detailed description of the split switches now in use is given. A table is also included and affords an easy means of comparison in regard to several important points.

Results of Tests

DATA resulting from a series of tests is frequently valueless and fails completely to furnish material of practical application. This is true more particularly of data which is primarily for design purposes and which must therefore be beyond criticism as to its practical relation to the design and its accuracy.

The engineer has his curve sheets and tables from which to calculate and design, such curves and tables being based upon formulas which are the result of theory and test. New data along the same line is to afford a check upon the formula which he has adopted as the basis for his designs. The method of obtaining the data must be such as to assure him that he is safe in applying it. If there is a doubt as to its accuracy it would be of little value to him.

A mistake is frequently made in attempting to cover too much in an investigation. For instance, four subjects may be covered and 25 tests made under each, while 100 tests under one subject would have been productive of better results. Thoroughness is absolutely necessary and cannot be emphasized too strongly.

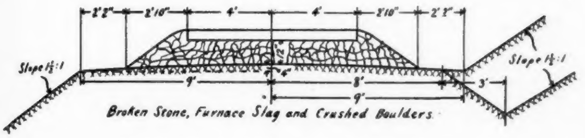
As an example the many tests of concrete might be cited. There are many points to be considered and it is often the case that too much is attempted at one time with the result that no dependence can be placed on the data obtained.

In regard to the shape in which such data should be presented, it might be said that the nearer in form it is to the original test sheet the better. Each test should be accompanied by remarks where such are necessary and the exact figures without any alteration should be given. When changes are made, the opinion of the tester is included in the data sheet. It is the wrong place to give his suggestions. His ideas should be given as a conclusion and appended to the data sheets.

The reason for the above statement is apparent to anyone who has desired to make use of such data in checking his formulas. The designer wishes to judge the data and draw his own conclusions, which may or may not agree with the experimenter's. No conscientious designer will take another's conclusions and apply them without verification.

Standard Track Sections

DESCRIPTIONS of track sections with tables of principal dimensions were given in the February issue for about 30 roads. The following descriptions of track sections were not given in the last issue, but the principal dimensions were included in the tables.

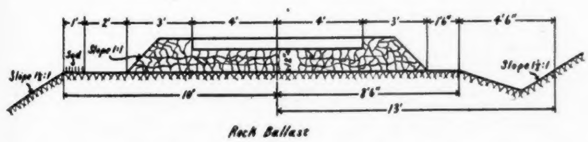


CHICAGO & ALTON TRACK SECTION

CHICAGO & ALTON RAILWAY.—The standard main track section with ballast of broken stone, furnace slag or crushed boulders is shown herewith. With gravel ballast the main track section is similar to the above with the exception of ballast slope. Gravel ballast is sloped from center of roadbed on a curve and is level with bottom of tie at the end of tie.

For double main track, the width of roadbed is 31 feet, the distance between centers of track being 13 feet. Between tracks large boulders are used instead of broken stone, etc., where the ballast is level with upper face of tie.

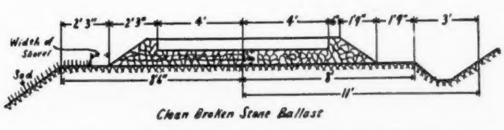
For side tracks, engine cinder ballast is used and its section is similar to that for broken stone ballast.



CHICAGO & NORTHWESTERN TRACK SECTION.

CHICAGO & NORTHWESTERN RAILWAY.—The standard track section for rock ballast is shown herewith. With gravel ballast the track section varies from the above only in the ballast section which has a slope from center of roadbed that gives 1 inch clearance under rail and 4 inches below upper face of tie at end of tie and which is 1½ to 1 from a point 1 foot 6 inches from tie to foot of ballast. At the center of roadbed, the gravel ballast is therefore about 3 inches above tie.

The double track sections are similar to single track, the distance between center of track being 13 feet. The width of roadbed is therefore 33 feet in cuts and 39 feet on fills.



CHICAGO, BURLINGTON & QUINCY TRACK SECTION.

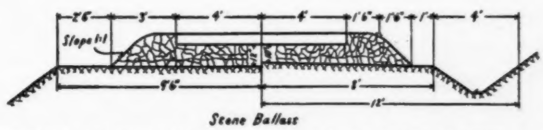
CHICAGO, BURLINGTON & QUINCY RAILWAY.—For the standard track section with stone ballast, 2,146 cubic yards of ballast are required on a basis of 3,200 ties, 6x8 inches by 8 feet, per mile.

With burned clay or clean fair-sized gravel, the depth of ballast and width of roadbed is the same as for stone ballast. The ballast has a slope of 1½ to 1 from a point, 10 inches from tie, to foot of ballast which is 2 feet 7 inches from end of tie.

It will be noted that the embankments are sodded to a point which is the width of shovel from foot of ballast. The slope of embankment in good earth is 1½ to 1 and in clear sand or sliding earth the slope is less, some sands requiring a 2 to 1 slope. In cuts, the earth slope is 1½ to 1 and the rock slope is ¼ to 1.

The width of roadbed on fills is maintained at 17 feet, new banks being constructed wider where it is necessary to insure 17 feet after settlement. Ditches are made approximately as indicated, the outline being as section shlusher scraper leaves it. Six-inch tile is located about 4 feet below subgrade.

For sidings and unimportant lines where no ballast and track is surfaced with material from side, the roadbed is 14 feet wide on fills and 20 feet in cuts. When earth is used, it is just level with bottom of tie at end of tie so as to drain well. The tie is lifted just enough to bring track to surface and tamp. The clearance between rail and earth is 2 inches.

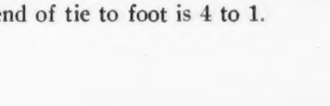


CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA TRACK SECTION.

CHICAGO, ST. PAUL, MINNEAPOLIS & OMAHA RAILWAY.—It will be noted in the drawing that the depth of ballast under center of ties is 2 inches less in cuts and that the subgrade has a slope of 2 inches in 7 feet.

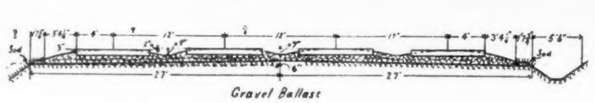
With gravel, cinders or very coarse sand ballast, the width of roadbed and depth of ballast is the same as for stone ballast. The distance from end of tie to foot of ballast on fills is 4 feet and in cuts 3 feet. The ballast slopes so as to give about an inch clearance under rail and from a point 2 feet from foot has a slope of 1½ to 1.

With ties laid on earth, the width of roadbed on fills is 14 feet and in cuts is 24 feet.



MISSOURI PACIFIC TRACK SECTION.

MISSOURI PACIFIC RAILWAY.—The ballast section, shown herewith, indicates that the depth of ballast under rail is about 2½ inches and that the slope of ballast from end of tie to foot is 4 to 1.



NEW YORK CENTRAL & HUDSON RIVER TRACK SECTION.

NEW YORK CENTRAL & HUDSON RIVER RAILROAD.—In the accompanying drawing, the standard track section for gravel ballast and four tracks is shown. The depth of ballast under center of tie from upper face of tie is about 15 inches for the inner tracks and 16 inches for the outer tracks.

In wet cuts farm tile, 6 or 8 inches, is used and protected by sod covering. In soft material the tile is laid in troughs, 5 feet below subgrade. The ditch is filled with clean gravel in the immediate vicinity of the tile and with porous material above the gravel. The ditch opposite drain boxes is also filled with cobbles.

The box drains are made of 6x6x2-inch planks and are placed 400 to 500 feet apart for draining depressions between tracks ballasted with gravel. The drains are placed deep enough to permit tamping and have an inclination of 1-inch per foot each way from center line of roadbed. The box drains are placed between ties under three of the tracks, one of the inner and two of the outer. Cobbles are used at drain openings and cover an area of 2 feet 6 inches by 3 feet. These box drains are treated with 3 coats of Woodiline or Fernoline or creosoted with dead oil of coal tar.

When the cuts are unusually wet, drains are also placed between tracks. When drains are unusually long, the diameter is increased near outlet.

Wherever the distance between centers of track is 13 feet, it is maintained, but elsewhere it is varied to suit local conditions, in no case being less than 12 feet. The distance from center of main track to center of adjacent siding is 13 feet.

Standard Rigid Frogs

THE various designs of standard rigid frogs in use on American railroads are described herewith. Data in tabulated form is also included. In the following description of frogs, the point referred to is the actual or ½-point unless otherwise stated.

CENTRAL RAILROAD OF NEW JERSEY.—The standard No. 8 rigid frog is 12 feet long and 7 feet 1½ inches from heel to point. The distance between actual and theoretical points is 4½ inches.

The standard No. 10 frog is 15 feet long and 8 feet 6⅜ inches from heel to point. The distance between actual and theoretical points is 5⅝ inches.

The point rails are bolted to wing rails through cast iron fillers with 1⅛-inch bolts for 80-pound rails and above and with 1-inch bolts for rails under 80 pounds. The point and wing rails are riveted to a ¾x16-inch plate with ⅞-inch rivets, countersunk in bottom of plate. The width of flangeways is 1⅞ inches and width at throat is 2¼ inches.

The standard special steel rigid frogs of sizes Nos. 3 to 15 inclusive have a steel center casting to which the wing rails are bolted. With the No. 8 frog, the casting is 7 feet 7 inches in length, the distance from point to heel end of casting being 4 feet 11½ inches.

CENTRAL OF GEORGIA.—The No. 7 rigid frog is 8 feet long and 5 feet from heel to point. The width of flangeway is 2 inches and width at throat is 2 inches. The frog is riveted to a steel plate.

CINCINNATI, HAMILTON & DAYTON RAILWAY.—The standard rigid frogs have 1¾-inch flangeways and 1¾-inch throats.

The point and wing rails are bolted through cast or rolled steel or rolled iron fillers with 1⅛-inch bolts for rails of 85 pounds or greater and with 1-inch bolts for rails of less than 85 pounds.

The center of first bolt through point rail is 2 15/16 inches back of actual point, the spacing of bolts being 5½ inches. Wing rails are bolted with an additional bolt 2 9/16 inches ahead of point. The fillers are solid and continuous, extending at least 4 inches ahead of point and at least 2 inches back of center of last bolt. The fillers fit the rail section, are cut to fit over rivet heads and are notched at point to form shoulder for the point.

Point rails are riveted together with at least two ⅞-inch rivets. Frogs of Nos. 12 to 20 inclusive have two additional rivets, one where rail heads join and other between this rivet and last bolt.

Under the point there is an 8x⅝ inch by 1-foot 4-inch plate to which the wing rails are riveted with ¾-inch rivets.

Frog No. 8 has a total length of 11 feet 5 inches, the distance from heel to point being 6 feet 11 inches; frog No. 10 has a total length of 13 feet 7¾ inches, the distance from heel to point being 8 feet 4 inches, and frog No. 12 has a total length of 18 feet, the distance from heel to point being 10 feet.

CHICAGO & ALTON RAILWAY.—The standard No. 10 rigid frog has a total length of 15 feet and is 8 feet from heel to point, the distance between actual and theoretical points being 5 inches. The width of flangeway is 1⅞ inches. The wing rail is 11 feet 4 inches long, the long point rail is 8 feet and the short point rail is 6 feet 4 inches.

The wing and point rails are bolted through a wrought iron filler with 1⅛-inch bolts, the weight of rail being 80 pounds. The wing rails are riveted to plate, ¾x16x22 inches by 4 feet 3 inches, with ⅞-inch rivets. The point rails are riveted with ⅞-inch rivets. A cast-iron toe block is used and an inverted old steel rail is used for the heel riser.

RAILROAD	Frog No.	Length feet	Heel to Point feet	Width of fla'ge-way, ins.	Width at throat ins.	Length of Wing Rail, ft.
C. R. R. of N. J.	10	15	8 13/24	1⅞	2⅛	10 9/24
Cent. of G.	7	8	5	2	...	6
C., H. & D.	10	13 31/48	8 1/3	1¾	1¾	....
C. & A.	10	15	8	1⅞	...	11 1/3
C., M. & St. P.	7+	9	4 11/12	1⅞	...	7
C., R. I. & P.	10	15	8 1/3	1¾	1¾	11
D. & H.	9	12	7 1/2	...	...	....
D. & R. G.	10	15	8 3/4	1¾	1⅞	9
G. N.	9	15	8	1⅞	...	11 1/2
Har. Lines	9	12	7 9/24	1¾	...	9 1/2
Inter-Col.	9	12 2/3	6 3/4	1¾	1¾	9 3/4
L. V.	10	15	9 1/12	1⅞	2½	10 1/3
N. Y., N. H. & H.	10	12 1/2	7 11/12	1¾	2¼	9 3/4
N. Y. C. & H. R.	10	15	9 1/6	1⅞	2¼	10
P. L. W. of P.	10	15	8 1/2	1¾	...	10 1/2
Pere Marq.	8	12	7 7/12	1¾	...	8 1/2
Phila. & Read.	8	15	8 5/6	1¾	2	11

Chicago, Milwaukee & St. Paul Railway.—The standard filled frog for 75-pound rail has a total length of 9 feet, has a spread at heel of 8½ inches, has an angle of 8 degrees and is 4 feet 11 inches from heel to point, the distance between actual and theoretical points being 1¾ inches. The width of flangeway is 1⅞ inches. The wing and point rails are bolted together through fillers and point rails are riveted together.

Chicago, Rock Island & Pacific Railway.—The rigid frogs, herein described, have 1¾-inch flangeways and 1¾-inch throats. The wing and point rails are bolted through a rolled steel filler with 1⅛-inch bolts for rails of 75 pounds or more. The point rails are riveted with ⅞-inch rivets. On all soft wood switch ties, on all treated switch ties and on all white oak switch ties where there is heavy traffic, tie plates are used between frog and tie.

Cast iron fillers are used between point rails, at throat and between heel riser and point rails.

The No. 10 rigid frog is 15 feet long and 8 feet 4 inches from heel to point. The No. 15 rigid frog is 20 feet long and 12 feet 6 inches from heel to point.

Delaware and Hudson Company.—The standard rigid frogs have two piece fillers between wing and point rails. The point rails are riveted together. The frog rests on plates to which the point rails are fastened by means of special angle bars, riveted or bolted to the base plate.

The No. 6 rigid frog is 9 feet long and 6 feet from heel to theoretical point; the No. 8 frog is 11 feet long and 6 feet 10½ inches from heel to theoretical point; the No. 9 frog is 12 feet long and 7 feet 10½ inches from heel to theoretical point, and the No. 12 frog is 15 feet long and 9 feet from heel to theoretical point.

Denver & Rio Grande Railroad.—The rigid frogs are bolted through wing rails, filler and point rails with ⅞-inch bolts for rails of 52 pounds or over and with ¾-inch bolts for rails under 52 pounds. The point rails are riveted with ⅞-inch rivets and wing rails are riveted to ⅝-inch plates of dimensions to suit frog. The width of flangeway is 1¾ inches and width of throat is 1⅞ inches.

The No. 7 frog is 15 feet long and 7 feet 6 inches from heel to theoretical point, the distance between actual and theoretical points being 3½ inches; the No. 8½ frog is 15 feet long and 8 feet 11 inches from heel to theoretical point, the distance between actual and theoretical points being 4¼ inches, and the No. 10 frog is 15 feet long and 9 feet 2 inches from heel to theoretical point, the distance between actual and theoretical points being 5 inches.

Great Northern Railway.—The standard rigid frogs have a 1⅞-inch flangeway. The wing and point rails are bolted through a rolled or cast steel filler with 1 or 1⅛-inch bolts. The wing rails are riveted to ½x6-inch tie plates of various lengths with ¾-inch rivets.

The No. 7 frog is 12 feet long and 7 feet from heel to point, the distance between actual and theoretical points being 3½ inches; the No. 9 frog is 15 feet long and 8 feet from heel to point, the distance between actual and theoretical points being 4½ inches, and the No. 15 frog is 20 feet long and 12 feet from heel to point, the distance between actual and theoretical points being 7½ inches.

Harriman Lines.—The standard rigid frogs have 1¾-inch flangeways. The wing and point rails are bolted with 1⅛-inch bolts through wrought iron fillers. The point rails are riveted with ⅞-inch rivets.

The No. 6 frog is 9 feet long and 5 feet 9 inches from heel to theoretical point, the wing rails being 7 feet 1 inch in length; the No. 7 frog is 10 feet long and 6 feet 6 inches from heel to theoretical point, the wing rails being 8 feet 1 inch in length; the No. 9 frog is 12 feet long and 7 feet 9 inches from heel to theoretical point, the wing rails being 9 feet 3 inches in length, and the No. 14 frog is 18 feet long and 11 feet from heel to theoretical point, the wing rails being about 12 feet 6 inches in length.

Intercolonial Railway.—The standard frogs are riveted to plates and straps with ¾ and ⅞-inch rivets. The point rails are riveted with ⅞-inch rivets.

The No. 9 frog for 80 pound rails is 12 feet 8 inches long and 7 feet 1½ inches from heel to point, the distance between actual and theoretical points being 4½ inches. A cast iron block is used at heel between wing and point rails which are held by a ¾x3-inch strap. The casting at point is 16 inches long and is riveted to plate. Castings are also used at throat between rails and also between rails and a ⅞x4-inch wrought iron strap, a 1-inch bolt passing through strap, fillers and rails. The bottom wrought iron plate is ¾-inch thick and 5 feet long.

Lehigh Valley Railroad.—The standard rigid frogs have a 1⅞-inch flangeway and 2½-inch throat. Bolts for 67 pound rail are 1-inch; for 80 and 90 pound

rail, $1\frac{1}{8}$-inch, and for 100 pound rail, $1\frac{1}{4}$ inch. Point rails are riveted with $1\frac{1}{8}$-inch countersunk rivets. Three wrought-iron tie-plates, $\frac{3}{4}$x6 inches, are used with the frog and these are riveted to wing rails with exception of plate at the point. Fillers are of rolled steel and cast iron.

The No. 10 frog is 15 feet long and 9 feet 1 inch from heel to point, the distance between actual and theoretical points being 5 inches; the No. 12 frog is 18 feet long and 11 feet from heel to point, the distance between actual and theoretical points being 6 inches.

New York Central & Hudson River Railroad.—The standard rigid frogs have $1\frac{7}{8}$-inch flangeways and $2\frac{1}{4}$-inch throats. Bolts are $\frac{7}{8}$-in. for 70-lb. rail, 1-in. for 75-lb. rail, $1\frac{1}{8}$-in. for 80-lb. rail and $1\frac{1}{4}$-in. for 100-lb. rail. Fillers are of cast iron or cast steel and are of two pieces between wing and point rails. Point rails are bolted together and frog is bolted to a $\frac{3}{4}$-in. steel plate, which in case of No. 10 frog is 6 ft. 6 ins. long and 1 ft. 9 ins. wide. The distance from heel to steel incline heel block is made not less than 1 ft. $6\frac{1}{2}$ ins.

The No. 6 rigid frog is 10 ft. long and 6 ft. 3 ins. from heel to point, the distance between actual and theoretical points being 3 ins. and the No. 10 frog is 15 ft. long and 9 ft. $\frac{1}{2}$ in. from heel to point, the distance between actual and theoretical points being 5 inches.

New York, New Haven & Hartford Railroad.—The rigid frogs have a $1\frac{3}{4}$-in. flangeway and $2\frac{1}{4}$-in. throat. The frog is bolted with $\frac{3}{4}$-in. for 74-lb. rail and 1-in. bolts for 100-lb. rail. Point rails are riveted together. The tie-plates for frog bearing are $\frac{1}{4}$x6 ins. and of varying lengths. The filler between point and guard rails is made in two pieces.

The No. 7 frog is 8 ft. 9 ins. long and 5 ft. 10 ins. from heel to theoretical point, the wing rails being 6 ft. 9 ins. long; the No. 10 frog is 12 ft. 6 ins. long and 8 ft. 4 ins. from heel to theoretical point, the wing rails being 9 ft. 9 ins. long, and the No. 15 frog is 18 ft. 9 ins. long and 12 ft. 6 ins. from heel to theoretical point, the wing rails being 14 ft. long.

Pennsylvania Lines West of Pittsburg.—The standard rigid frogs have $1\frac{3}{4}$-in. flangeways. The wing and point rails are bolted through a filler with 1-in. bolts for rails less than 85 lbs. and with $1\frac{1}{8}$-in. bolts for rails of 85 and 100 lbs. The point rails are riveted with $\frac{7}{8}$-in. rivets. The point of the frogs rests on a $\frac{5}{8}$x8x17-in. tie-plate to which frog is riveted.

In the toe of the frog and at the flare on heel end of wing rails, $\frac{3}{8}$-in. by about $2\frac{1}{2}$-in. steel bands of various lengths are bolted to wing rails, and these bands maintain the required distance between rails.

The No. 10 rigid frog is 15 ft. long and 8 ft. 6 ins. from heel to point; the No. 12 frog is 18 ft. long and 10 ft. from heel to point, and the No. 20 frog is 27 ft. long and 17 ft. 6 ins. from heel to point.

Pere Marquette Railroad.—The No. 8 rigid frog is 12 ft. long and 7 ft. 7 ins. from heel to point. The width of flangeway is $1\frac{3}{4}$ ins. The frogs are bolted through filler with 1-in. bolts. The spread at heel is $10\frac{5}{8}$ ins.

Philadelphia & Reading Railway.—The standard bolted and stiff rail frogs have $1\frac{3}{4}$-in. flangeways and $2\frac{1}{8}$-in. throats for frogs up to No. 6 and 2-in. throats for frogs above No. 6. The frogs are bolted with $1\frac{1}{8}$-in. bolts and wing rails are riveted to wrought iron or rolled soft steel tie-plates with $\frac{1}{2}$-in. rivets. The point rails are held together with $\frac{3}{4}$-in. rivets. The fillers between wing and point rails at point are of wrought iron and beyond points of cast iron. A cast iron filler is used between wing rails at throat.

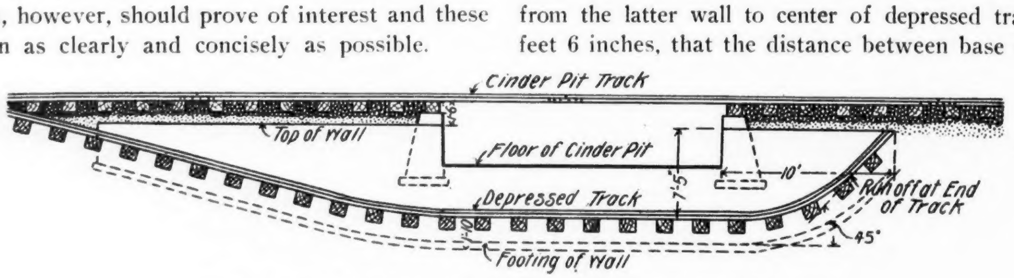
Standard frogs, Nos. 3 to 11 inclusive, are 15 ft. long and 8 ft. 10 ins. from heel to point, the wing rails being 10 ft. long for Nos. 3 to 5 inclusive, and 11 ft. for Nos. 6 to 11 inclusive; frogs Nos. 12 to 16 inclusive are 20 ft. long and 12 ft. from heel to point, the wing rails being 14 ft. 5 ins. long and the No. 20 frog is 26 ft. long and 16 ft. from heel to point with wing rails 17 ft. long.

Depressed Cinder Pit

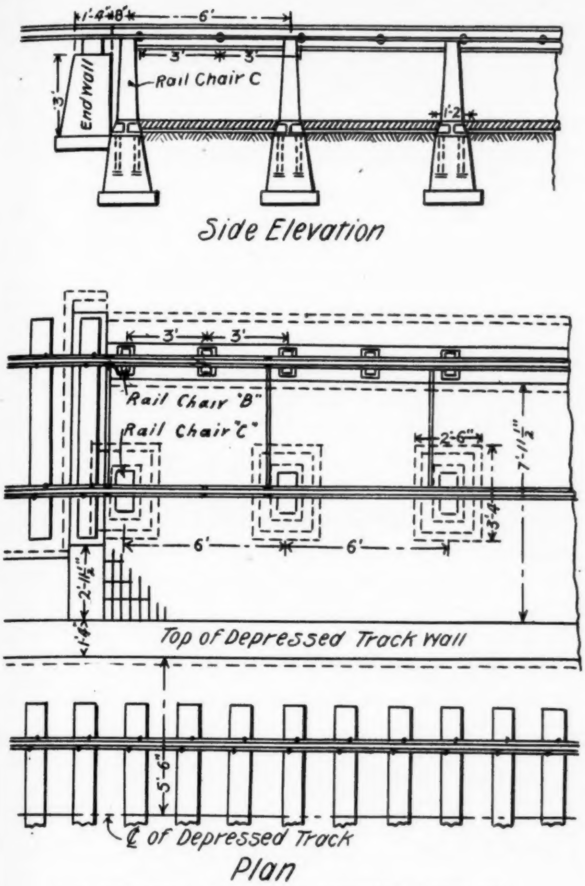
Central of Georgia Railway

The standard depressed cinder pit of the Central of Georgia Railway, which is shown herewith, is a type that is in common use. The details of construction, however, should prove of interest and these are given as clearly and concisely as possible.

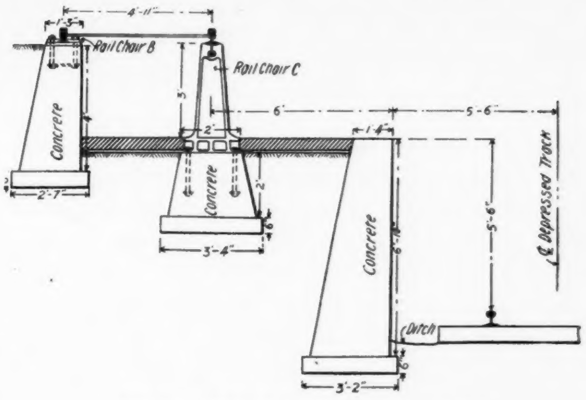
In the first place it will be noted that the total width of cinder pit from cinder pit wall to depressed track wall is about 10 feet 4 inches, that the distance from the latter wall to center of depressed track is 5 feet 6 inches, that the distance between base of track



PROFILE SHOWING DEPRESSED TRACK IN RELATION TO CINDER PIT.



SIDE ELEVATION AND PLAN OF DEPRESSED CINDER PIT.



END ELEVATION OF DEPRESSED CINDER PIT.

rail and floor of cinder pit is 3 feet and the depth of depressed track below surface of pit is 5 feet 6 inches. These dimensions allow cinders to be handled readily from engine to cars on depressed track.

The floor of the pit is paved with vitrified brick laid on edge on 1-inch of sand and grouted with neat cement mortar after being laid. The ground should be well puddled and tamped before the pit is paved.

Rail chairs, B, are placed every 3 feet along top of wall. They are made up of two ¾x11-inch anchor bolts, placed in 2-inch old gas pipe, 6 inches long, and fastened to a 3x10-inch plate washer; bolts, gas pipe and washer are built into the concrete. The bolts pass through a plate, 8x12½ inches, which is grooved to fit rail. Washers 4x4¼ inches and about 1¼ inches thick, hold the rail to plate.

Rail chairs, C, are of web construction, the section being an "I" shape and the metal being 1¼ inches in thickness. The base of the chair measures 1 foot by 10 inches. The chair is anchored to concrete piers with four 1-inch bolts, 1 foot 6 inches long, set in 2-inch old gas pipe. The chair is slotted at the top to give a loose fit to an inverted rail. The track rails are riveted to the inverted rails every three feet with two ¾-inch rivets. The rails are drilled, placed in position and then riveted.

The main track rails are braced with ¾-inch rods, 5 feet 2 inches long, which are placed on 6-foot centers. The rods are bolted to the rails.

The depressed track wall is duplicated on opposite side of track where topography makes it necessary.

Standard Split Switches

SPLIT switches standard on American railroads are described in the following article. A comparison is also assisted by means of the accompanying tabulated data.

Central Railroad of New Jersey.—The switch rail is planed down on top a total of 1 in. at point. Beginning 8 ins. back of the side planing, which is determined by angle of switch, the switch rail is planed down on top ¾ in. at the extreme point and then beginning 12 ins. back of point it is planed down an additional ¼ in. Beginning 12 ins. back of point the switch rail is chamfered to ⅛-in. thickness at extreme point and then the point is filed and rounded. The thickness at point after planing and before filing and chamfering is ¼ in.

The tie rods are made of ¾x2½-in. bars. Where insulation is necessary, the rods are made in two pieces and held by ½x2½x12-in. wrought iron splice plates, insulated with ⅛-in. fiber strap from tie rods, with ⅝-in. bolts in fiber bushings. Before and after assembling, a coat of insulating paint is applied to the insulated joint.

The tie plates are made of forged soft steel and are ½ in. thick with ⅜-in. risers. Back of the rail joints ½-in. tie plates are used under high rail to bring stock and point rails level at third tie back of joint; the ties being adzed to a true bearing before plates are applied.

Rail braces are made of cast iron. Reinforcing straps are 6 ft. 6 ins. in length, for 15-ft. switch. Two stops

of ⅝x1⅜-in. material are placed 10 ft. back from point of 15-ft. switch.

The 15-ft. split switch has two tie rods; the 20-ft. switch has three tie rods, and the 30-ft. switch has four tie rods. The switch rail is ⅝-in. below stock rail at point, is ⅜-in. below stock rail 12 ins. from point, is ⅜-in. above stock rail about 7 ft. from point and it remains at elevation of ⅜-in. above stock rail to heel of switch, falling to level of stock rail at third tie from heel of switch.

Chicago & Alton Railway.—The standard 18-ft. split switch for 80-lb. rail has a 4¾-in. throw. The stock rail is bent 10½ ins. from point, giving a gauge at point of 4 ft. 8 9/16 ins.

The switch rail is ⅝-in. below stock rail at point, is 3/16 in. below stock rail 18 ins. from point, is ⅛ in. above stock rail at about 7 ft. from point, is 3/16 in. above stock rail at 11 ft. from point and then falls to level of stock rail at heel of switch.

The switch rails are reinforced with a ⅜x2 15/16-in. plate, 16 ft. long, which is riveted to the rail with ¾-in. rivets. The tie plates are made of ½-in. material with pressed risers for switch rails. Four tie rods are used and placed on 3-ft. centers.

The switch rail is planed on top a distance of 11 ft. from point. Beginning 11 ft. back of switch point it is planed down ⅛ in. for a distance of 3¾ ft., then 7/16 in. for the next 5¾ ft. and 7/16 in. for the remaining 1½ ft., making a total of 1 in. at extreme point.

Chicago & Northwestern Railway.—The standard 15-ft. split switch for 90-lb. rail has a 5-in. throw. The stock rail is bent 1 ft. 1¼ ins. from point, giving a gauge of 4 ft. 8⅝ ins. at point of switch.

The switch rail is ⅝ in. below stock rail at point, is 7/16 in. below stock rail 10 ins. from point, is ⅜ in. above stock rail 5 ft. from point, remains at elevation of ⅜ in. above stock rail for 2 ft. 3 ins. and then falls to level of stock rail in the next 5 ft. 3 ins.

The switch rail is planed down on top of head 1 in. in a distance of 5 ft. from point, it is planed on sides of head a distance of 6 ft. 10 7/16 ins. and on flange the entire length of rail.

Chicago, Burlington & Quincy Railroad.—The 15-ft. switch for 85-lb. rail has a throw of 3½ ins. The stock rail is bent 8 9/16 ins. from point on an angle of 1 deg. 40 mins. Two tie rods are used, the first having two length adjustments and the second one adjustment.

The switch rail is ⅞ in. below stock rail at point, is level with stock rail 1 ft. 2 ins. from point, rises to an elevation of ¼ in. above stock rail 2 ft. 8 ins. from point, remains at elevation of ¼ in. above stock rail for a distance of 3 ft. 3 ins. and then falls to level of stock rail at heel of switch.

Chicago, Milwaukee & St. Paul Railway.—The 15-ft. standard split switch has a throw of 5 ins. The stock rail bend is 9 ins. from point of switch. Two tie rods are used, one of which is adjustable as to length.

The head of switch rail is planed down a total of 1¼ ins. Beginning 3 ft. 10 ins. from switch point, it is planed ⅜ in. in 2 ft. 8 ins. and ⅞ in. in the remaining 14 ins. to point.

The switch rail is ⅞ in. below stock rail at point, is level with stock rail 14 ins. back of point, is ⅜ in. above stock rail 3 ft. 10 ins. back of point, is on an elevation of ⅜ in, for 3 ft. 3 ins. and falls gradually to level of stock rail at heel of switch.

Chicago, Rock Island & Pacific Railway.—The 15-ft. split switch has a 4¾-in. throw at switch rod. The bend in main stock rail is 1/16 in., beginning 11 ins. from point, which gives a gauge of 4 ft. 8 9/16 ins. at switch point.

The switch rail is ⅝ in. below stock rail at point, is level with stock rail 18 ins. from point, rises ¼ in. above stock rail 6 ft. 6 ins. from point, is on an elevation of ¼ in. above stock rail for a distance of 4 ft. 8¾ ins. and then falls to level of stock rail at heel of switch.

Two adjustable switch rods are used. Tie plates are ⅝-in. in thickness with pressed risers. Reinforcing plate for switch rail is 13½ ft. long.

The 24-ft. switch has four adjustable tie rods. The top of switch rail is planed down ⅞ ins. The switch rail is ⅝ in. below stock rail at point, rises to same level 3 ft. 6 ins. from point, rises ¼ in. above stock rail 10 ft. 6 ins. from point, remains ¼ in. above stock rail for a distance of 9 ft. 3¾ ins. and then falls to same level at heel of switch. The stock rail bend begins 1 ft. 5¼ ins. from point, the gauge at point being 4 ft. 8 9/16 ins. Reinforcing plates for switch rails are 22 ft. in length. The switch angle is 1 deg. 02 mins. 40 secs.

Chicago, St. Paul, Minneapolis & Omaha Railway.—The 15-ft. standard split switch has a 5-in. throw. Two adjustable tie rods are used. Reinforcing plates for switch rails are 15 ft. in length.

The switch rail is planed down on top a distance of 9 ft. and planed down ⅝ in. in the 18 ins. approaching point. Tie plates with pressed risers are used. Two gauge plates are used, one at point and other about midway between point and heel.

Chicago, Hamilton & Dayton Railway.—The 16½-ft. switch for 85-lb. rail has a 5-in. throw. The stock rail is bent 10½ ins. from point.

The switch rail is planed down ¾ of an inch in the 5 ft. to point. At point switch rail is ½ in. lower than stock rail, it rises ¼ in. above stock rail at distance of 5 ft. from point, it is level with stock rail for a distance of 6 ft. 6 ins. and it falls to level of stock rail in the next 3 ft. 6 ins.

Reinforcing plates are ⅜ in. in thickness and 13 ft. in length. Tie plates with pressed risers are used. Gauge plate is used at point and stops at distance of about 10 ft. from point.

Cincinnati Northern Railroad.—The 15-ft. switch has a 5-in. throw. The stock rail is bent 9 ins. from point. Four tie rods are used.

Railroad—	Length of switch (feet)	Switch below stock rail at point (inches)	Throw of switch (inches)	Switch rail planed down (inches)	Width of switch rail at point	Elevation of switch above stock rail (inches)
C. R. R. of N. J.	15	5/8	4	1	1/8	....
C. & A.	18	5/8	4 3/4	1	1/8	1/8
C. & N. W.	15	5/8	5	1	1/4	3/8
C., B. & Q.	15	7/8	3 1/2	1⅛	1/4	1/4
C., M. & St. P.	15	7/8	5	1¼	....	3/8
C., R. I. & P.	15	5/8	4 3/4	⅞	1/4	1/4
C., St. P., M. & O.	15	5/8	5	...	1/4	....
C., H. & D.	16½	1/2	5	¾	1/16	1/4
Cin. North	15	....	5	...	3/16	....
D. & H.	15	5/16	3 7/8	⅝	3/8	5/16
D. & R. I.	15	1/2	4 5/8	⅞	3/16	....
G. N.	16½	5/8	5	⅞	5/16	1/4
Har. Lines	15	5/8	5	⅞	1/4	1/4
Ill. Cent.	15	3/8	4 9/16	¾	1/8	....
Inter-Col.	15	5/8	5	⅝	1/8	1/4
L. V.	15	3/8	4	⅝	1/16	1/4
M. Cent.	15	3/4	5	1⅛	....	....
Mo. Pac.	13	1/2	4 1/2	1	....	1/4
N. Y., N. H. & H.	15	3/8	3 7/8	⅜	1/8	3/16
N. Y. C. & H. R.	15	5/8	4	⅝	1/8	1/4
P. & L. W. of P.	18	1/2	4 1/2	¾	1/16	1/4
Pere Marq.	15	5/8	5	¾	....	1/8
P. & R.	15	5/8	4	1	1/8	....
Wabash	15	3/4	4 1/2	⅞	....	1/4

Delaware & Hudson Company.—The 15-ft. switch rail is planed down ⅝ in. on top a distance of 5 ft. 3 ins. from point. The switch rail is 5/16 in. below stock rail at point, it rises to an elevation of 5/16 in. above stock rail in distance of 5 ft. 3 ins., is on elevation of 5/16 in. for a distance of 1 ft. and falls to level of stock rail in the next 5 ft.

Four tie rods are used and tie plates are used up to fourth tie rod, that is six tie plates on each rail. The gauge at point 4 ft. 9 ins.

Denver & Rio Grande Railroad.—The 15-ft. standard split switch has a 4⅝-in. throw. The stock rail is bent 6⅜ ins. from point on bend of 1 in 34. Four tie rods are used and placed on 3-ft. 4-in. centers.

The switch rail is planed down a total of ⅞ ins. and is ½ in. below stock rail at point. The width of switch rail is 1/16 in. at point.

Great Northern Railway.—The 16½-ft. split switch has a 5-in. throw. The stock rail is bent 12 ins. from point.

The switch rail is planed down ⅞ in. on top. It is ⅝ in. below stock rail at point, it rises to level of stock rail at distance of 2 ft. from point, it rises ¼ in. above stock rail in the next 5 ft. and then falls to level of stock rail at heel of switch.

Tie plates are ½-in. in thickness with pressed risers from 1/16 to ⅜ in. Reinforcing plates for switch rail are 15 ft. and 13 ft. 8¼ ins. in length.

Harriman Lines.—The 15-ft. split switch has a 4¾-in. throw. The stock rail is bent 11½ ins. from point, giving a gauge at point of 4 ft. 8 9/16 ins.

The switch rail is ⅝ in. below stock rail at point, is level with stock rail 18 ins. from point, rises ¼ in. above stock rail 6 ft. 6 ins. from point and then falls gradually to level of stock rail.

Two adjustable insulated tie rods are used. Reinforcing plate for switch rail is 13½ ft. long.

The 24-ft. switch rail is ⅝ in. below stock rail at point, is level with stock rail 3 ft. 6 ins. from point, rises ⅜ in. above stock rail 10 ft. 6 ins. from point, is at an elevation of ⅜ in. above stock rail for a distance of 2 ft. 3¾ ins. and then falls to level of stock rail. The bend in stock rail is 1 ft. 5½ ins. from point. Four insulated adjustable tie rods are used and placed 3 ft. 2 ins. on centers.

Intercolonial Railway.—The 15-ft. standard split switch has a 5-in. throw. The stock rail is bent 1 ft. 4⅜ ins. from point. Two adjustable tie rods are used.

The switch rail is ⅝ in. below stock rail at point and rises ¼ in. above stock rail 5 ft. from point. Reinforcing plate for switch rails is 15 ft. long.

Illinois Central Railroad.—The 15-ft. standard split switch has a 4 9/16-in. throw. The stock rail is bent 9 ins. from point, giving a gauge at switch point of 4 ft. 9 ins.

The switch rail is planed down ¾ ins. in 6 ft. It is about ⅜ in. below stock rail at switch point, rises about ⅛ in. above stock rail at distance of 6 ft. from point and then falls to level of stock rail at heel of switch.

Two adjustable tie rods are used. Reinforcement plates for switch rail are 13 ft. 2 ins. long and 12 ft. 10 ins. long.

Lehigh Valley Railroad.—The 15-ft. standard switch has a 4-in. throw. The stock rail is bent 12 ins. from point, giving a gauge of 4 ft. 8⅞ ins. at switch point.

The switch rail is planed down ⅞ in. on top for rails under 90 lbs., either ⅝ or ⅞ in. for 90-lb. rail, depending on type, and ⅝ in. for 100-lb. rail. With 90 A and 100 A rail the switch rail is ⅜ in. below stock rail at point, rises to ¼ in. above stock rail at distance of 5½ ft., is at elevation of ¼ in. above stock rail for 5½ ft. and then falls to level of stock rail at heel of switch.

Two tie rods are used, which have an insulated joint if necessary. Reinforcing bars for switch rail are 9 ft. 5 ins. long.

With the 21-ft. standard switch the throw is 4 ins. and three tie rods are used. The switch rail rises ¼ in. above stock rail 6 ft. 6 ins. from point.

Michigan Central Railroad.—The standard 15-ft. switch has a 5-in. throw. The stock rail is bent 8 ins. from point.

The switch rail is ¾ in. below stock rail at switch point. The total amount planed from top of rail is 1⅛ ins., beginning 10 ft. back of point. The switch and stock rails are on same level, 2 ft. back of point. Two adjustable tie rods are used.

Missouri Pacific Railway.—The standard 13-ft. split switch has a 4½-in. throw. The stock rail is bent 8½ ins. from point.

The switch rail is ½ in. below stock rail at point, is level with stock rail 2 ft. 9 ins. from point, is ¼ in. above stock rail 4 ft. from point, remains at an elevation of ¼ in. above stock rail for 4 ft. and falls to level of stock rail at heel of switch. Two adjustable tie rods are used.

With the 11-ft. switch the throw is 4½ ins. and bend in stock rail is 7 ins. from point.

New York, New Haven & Hartford Railroad.—The 15-ft. standard split switch has a 3⅞-in. throw. The stock rail is bent 11¾ ins. from point.

The switch rail is ⅜ in. below stock rail at point, it rises 3/16 in. above stock rail at distance of about 5 ft. 6 ins. from point and then falls gradually to same level at a distance of about 4½ ft. Five tie rods are used and placed on 2-ft. centers.

With the 24-ft. switch, the stock rail is bent 22⅝ ins. from point. Seven tie rods are used.

New York Central & Hudson River Railroad.—The 15-ft. switch has a 4-in. throw. The stock rail is bent 1 ft. 4¾ ins. from point.

The switch rail is ⅝ in. below stock rail at point, is ¼ in. above stock rail 5 ft. from point, remains at elevation of ¼ in. above stock rail for 5 ft. and then falls to level of stock rail.

Two adjustable tie rods are used. Reinforcing plates are ⅜ in. in thickness and extend the length of switch rail.

Pennsylvania Lines West of Pittsburg.—The 18-ft. standard split switch has a 4½-in. throw. Two adjustable tie rods are used. Reinforcing plates are 16½ ft. in length.

The switch rail is ½ in. lower than stock rail at point, is level with stock rail about 2 ft. 9 ins. from point, is ¼ in. above stock rail 5 ft. 3 ins. from point, remains at an elevation of ¼ in. above stock rail for a distance of 5 ft. and then falls to level of stock rail in the next 5 ft. 3 ins.

With the 30-ft. switch, the switch rail is ½ in. below stock rail at point is ¼ in. above stock rail 9 ft. from point remains at ¼ in. above stock rail for 10 ft. and then falls to elevation of stock rail in the next 8 ft. Five tie rods are used, two of which are adjustable.

Pere Marquette Railroad.—The 15-ft. standard split switch has a 5-in. throw. Two adjustable tie rods are used.

The switch rail is ⅝ in. above stock rail at point, is level with stock rail at distance of 18 ins. from point, is ⅛ in. above stock rail at distance of 8 ft. from point and then falls to level of stock rail at heel of switch.

Philadelphia & Reading Railway.—The standard switches have a 4-in. throw. The construction is similar to that of the Central Railroad of New Jersey.

Wabash Railroad—The standard 15-ft. split switch for 70-lb. rerolled rail has a 4½-in. throw. The stock
The switch rail is ¾ in. below stock rail at point, is
rail is bent 8 ins. from point.

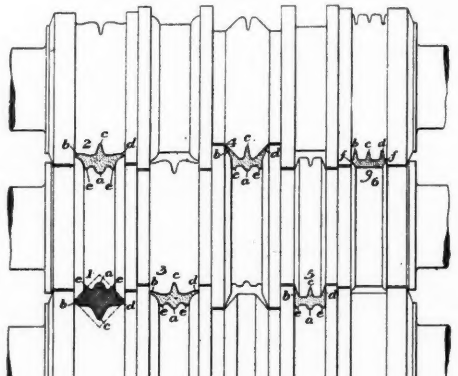
½ in. below stock rail 8 ins. from point, is ¼ in. above stock rail 5 ft. 3 ins. from point and then falls to level of stock rail about 12 ft. from point of switch.

Rolling Tie Plates

THIS method of rolling longitudinally-flanged tie-plates is said to be efficient and economical. The number of passes and number of operations are reduced to a minimum. The method was patented by Andrew Morrison, Pittsburg, Pa.

A front elevation of a three-high rolling mill having a series of passes for forming the plates is shown in Figure 1; a similar view of the final or finishing pass is shown in Figure 2, and a sectional view of the completed tie-plate is shown in Figure 3.

In carrying out the method a bar, billet or bloom of rectangular cross section is introduced in diagonal position into the first pass 1 of the mill, and its corner portions are reduced to form the rudimentary flanges, a, b, c, and d; that is to say, the bar or billet is sent through the first pass with one of its diagonals in vertical position; and the converging walls of the pass-grooves in the rolls reduce the four corner portions to form these rudimentary flanges. At the same time there are usually formed at each side of the flange a auxiliary projections or bumps e. After this first reduction, the partially-reduced shape is inverted and sent through the pass 2, in which the flanges b, c,



METHOD OF ROLLING TIE PLATES.

and d, together with the body portion are further reduced and shaped. The bar is then sent in succession through the passes 3 and 4 in which a further reduction is effected and the flanges are further shaped, the flange or bump a supporting the flange c and being gradually rolled into the body portion and support of the flange. In the pass 5, the flanges b and d are bent into position at substantially right angles to the body, and in the sixth pass, these flanges are crowded inwardly towards each other and at the same time, the body of the metal is crowded laterally beyond the flanges to form the longitudinally-extending reduced lateral flange extensions f at each side of the rail bearing surface g of the bar. These two steps may, however, be performed in separate passes. In this sixth pass the bumps a and e are rolled entirely into the body and support the other flanges as well as form the lateral extensions of the plate. It is not necessary, however, to roll out the bump a in this pass, as this may be done in one of the preceding passes or in a subsequent pass.

The bar is now sent through the finishing pass 7 (Fig. 2), where it is reduced to its final thickness, and rail bearing shoulders h are rolled therein by means of the grooves 9 in one of the rolls 10, these shoulders extending preferably across the entire rail bearing surface of the tie-plate. The finished bar is then sheared into lengths and punched.

In some cases the bumps a and e may be omitted, and the upper corner portion of the billet rolled down into the body and the central flange c. The formation of the shoulders h in the final or finishing pass may also be dispensed with, or their form and length varied, as may be desired, by a corresponding change in the roll 10. It is not necessary to reverse the bar at the second pass as that is merely done to reduce the required length of rolls.

It will be noted that by employing a rectangular bar which is rolled in diagonal position, the breaking down of the bar to form the rudimentary flanges is easily effected in a single pass, and that these rudimentary flanges are of such form and so disposed as to make the subsequent reduction and shaping of the bar easily effected by a minimum number of operations.

By utilizing two of the corner portions of the bar or billet for the purpose of forming the middle flange of the finished plate, a deeper middle flange can be produced than is possible by any method heretofore known.

Recently the Public Service Commission in New York had a hearing to ascertain why automatic train control should not be adopted on the local tracks of the Rapid Transit subway, as they are being used on the express tracks. General Manager Hedley is quoted as stating that these automatic train control devices would to some extent reduce the frequency of the service.

Steel Rail Specifications

THE Pennsylvania Railroad Company placed definite orders with steel manufacturers for 55,000 tons of rails to be delivered during 1908. These, in addition to 30,000 tons left over from 1907, will give the company 85,000 tons for use this year.

These rails will be rolled under entirely new specifications. In view of the increasing severity of road service and the recognized necessity for developing an improved steel rail, the Pennsylvania Railroad has for some months been conducting an exhaustive examination of the entire art and practice of rail manufacture. A committee of experts—representing not only the railroad but two of the important steel manufacturers—was appointed by the Pennsylvania System last summer to make a special study of the subject.

The series of experiments undertaken were probably unprecedented in their completeness and in the importance of the scientific data which they supplied. The rail sections are believed to be a distinct improvement upon those hitherto in use on the Pennsylvania System.

Most important of the features of the new specifications is the placing more upon the manufacturer the responsibility for the character of the rail produced. The company recognizes that it is merely a purchaser —not a manufacturer. Considerable latitude is, therefore, to be allowed in the methods of manufacture utilized, so long as the result is a sound rail. The company has devised tests of a character so exacting that it is made very much to the interest of the manufacturers to discard all material of the soundness of which there is any doubt.

No specification, for example, is made as to the amount which shall be sheared from the end of the bloom formed from the top of the ingot. The problem of a proper discard has been discussed very freely by the different societies which have been considering rail specifications. Various percentages have been proposed—a discard of 25 per cent having the greatest number of advocates. The Pennsylvania Railroad feels, however, that, in the present state of the art, at any rate, the responsibility for a proper discard should be left with the manufacturer.

The new specifications also provide that rails shall be free from "injurious" mechanical defects and flaws. This differs from the old specifications in that no attempt has been made to describe the particular defects or flaws that will cause the rejection of rails. It is not considered wise to attempt to classify in the specifications the relative importance of defects, but it is specified that no rails will be accepted that contain defects or flaws which in any way impair their strength.

The methods to be used in testing the new rails are very elaborate and comprehensive. To still further strengthen the practice of the company and to insure that whatever future changes are made shall be based

upon accurate data, a system has been devised whereby the history of all rails purchased by the company shall be fully recorded. In order that for this purpose it may be possible to identify the part of the ingot from which particular rails were made, the new specifications require, in addition to the usual marking, that a letter shall be stamped on each rail to indicate its position in the ingot.

To compile and consider the company's experience with rails, a special committee is to keep continually in thorough touch with the art, and is expected to supply the company with data that will enable it to secure the best rails which, at the time of any order, it is possible to manufacture.

In placing its orders, the Pennsylvania Railroad invites the steel manufacturers to undertake to fill part of the allotment with rails made by the open hearth process. It is desired to ascertain more clearly the actual differences in service as between the open-hearth and the Bessemer product.

Track and Ballast

AT a recent meeting of the Iowa Railway Club, Mr. H. Rettinghouse, division engineer, Chicago & Northwestern Railway, presented a paper on "Track and Ballast," and on the same evening a paper, prepared by Mr. Auerbach, roadmaster of the Chicago Great Western Railway, was read. Extracts from the paper by Mr. Rettinghouse follow.

The question was once propounded to an old friend of mine, a division superintendent, and a good trackman of the old school, as to the different classes of track. He replied in his blunt old way, that there were three of them. First, good track; second, poor track; third, very poor track. (For the third class he really used a different adjective, which would not look very good in print, and is therefore omitted.) On being asked as to how to bring the last two-named classes up to the standard of the first named, he replied that in order to bring this about it meant: Good roadbed and drainage, good ballast, good ties, good rails and fastenings, and last but not least, good men. My experience shows me that this definition comes as close to the requirements for good track as it could be made, and further that when good track has once been built it requires constant and unimpaired attention for every day out of the year to so keep it. In these days of keen competition it is necessary that all track should be good and at least commensurate with its particular requirements so as not to jeopardize the safety of the traveling public and trainmen as well as valuable property.

What then is good track? In the words of my old friend quoted above, it means:

First, good roadbed and drainage. Often have I seen through bad management and judgment car load after car load of gravel or cinders, or other dry material put under track in some particularly soft cuts, only to churn up in a short while with the underlying soft mud, when good judgment and good management would have dictated comparatively little work in the way of drainage ditches and tiling with certain better results. Good drainage should be had in mind during the construction of the roadbed, which roadbed itself should be built with extreme care. Ditches in cuts and along low embankments should in all cases, wherever practical, be made continuous and leading to the nearest outlets. Adequate waterways under tracks should be built and in fact the question of drainage should be paramount. We are profiting by the errors of the past and while conditions even now arise that could not possibly have been foreseen and set to naught the finest calculations, it is nevertheless a fact that modern engineering methods as applied to drainage problems in the way of determining drainage areas and the consequent volumes of drainage to be disposed of, are doing much towards perfecting drainage conditions and thereby helping to make good track. In the colder climates, especially where track maintenance is a difficult problem through the heaving of track, there should be more attention paid to perfect drainage of roadbed, than at such location where frost does not penetrate to a depth so as to bring heaving of track about. The roadbed should not only be perfectly drained, but should be of proper consistency to receive ballast and track, so that the material from the roadbed will have no tendency to churn up with the ballast after it is placed upon same. If the material forming the construction of roadbed is of such nature that it will not fulfill these conditions, it is often necessary to place a layer of cinders or coarse rock on top of such roadbed, so as to leave the subsequent ballast unimpaired.

Second, good ballast.—Without going too deeply into the subject and taking up too much of your time, I will confine myself to those kinds of ballast which are mainly in use and which have come under my personal observation. I have already enlarged under the subheading of "Good Roadbed and Drainage" on the necessity of properly preparing the roadbed, and you will pardon me for again referring to same—that very important preliminary to the placing of all ballast and so essential to the success of same, should be prominently but briefly mentioned. I refer to the proper preparation of the roadbed and sub-grade. I believe in the united opinion of all true trackmen that the roadbed should be slightly sloped from the center line of track each way so as to permit of quick drain-

age of such moisture, which will penetrate through ballast. While it is easy to do so with new beds previous to the laying of track, it is an equally difficult undertaking, at least entirely so, with old track to be reballasted. In that case it is highly essential that the old ballast be removed from between the ties to the bottom of ties at the ends; the excavated material to be properly leveled off to the shoulder of the roadbed, so as to leave no ridges and leave no obstruction to the flow of sub-drainage. So much for this essential preliminary work. Now as to the different kinds of ballast that have come under my personal charge and observation, and as I adhere to the maxim that no one should attempt to talk about things of which he knows nothing and much less to tell others how to do such things, I will mention those kinds of ballast only that have come under my personal charge and observation. I will name the following: (a) Broken stone or slag; (b) gravel or sand; (c) cinder ballast, and (d) earth ballast.

Broken Stone or Slag.—I have placed this class of ballast at the head of my list and by right of conquest it should as it is the undivided opinion of all track men based on their experience that there is nothing better than stone ballasted track from all points of view. Opinions differ, however, as to the size of crushed stone or slag. Some advocate crushed stone averaging two inch cubes, absolutely clean and free of stone dust, and in order to so insure a clean material, to have the same washed. Others advocate the size as low down as ¾ inch, while others advocate a mixture of both and intervening sizes, and still others advocate a crusher run article with a limit to two inch sized stones and a certain portion of dust to remain in the mixture. As for myself I advocate the size last named and my reasons are found through facts of experience. I find that with broken stone or slag there is a tendency for the sharp edges of the fragments of stone to bury themselves in the bottom of the ties through the impact of trains, and I found it difficult to keep track in good line through the further tendency of broken stone fragments to roll one way or the other and on lining track they would naturally tend to again crowd back and throw track out of line. With the mixed material this objection is reduced to a minimum and the smaller particles will fill out the voids between them. As to the small amount of dust, it will with a few rains finally wash down to the sub-grade and by forming a coating over same, rather be helpful than detrimental to drainage. The claim has often been made that broken stone or slag is too expensive as compared with others, as for instance gravel. As for myself I cannot agree with such an opinion as the one item of life of ties alone is an important factor in the cost of maintenance and the very porous nature of such ballast prevents its speedy fouling and thereby proves a long time investment. The thickness of stone or slag ballast and for that matter all other ballast should be no less than twelve inches from sub-grade to bottom of ties, while eighteen inches would be much better. The material should be hard and not subject to crushing through traffic. Limestones and granites, trap and flint rocks are most commonly in use, while only the hardest sand stones are admissible.

Gravel and Sand.—Up to and for some time after the advent of broken stone on the ballasting market, gravel was considered the peer of all and even at the present time its advocates form a goodly number. The justness of such claims should not be denied were it not for the fact that good gravel is extremely scarce, and without going too far into a definition of good gravel, I will briefly state that it must be composed of such stony parts that will not rapidly decay, and run in sizes from coarse sand to two inch diameter pebbles. There must be no clay or earthy substance contained within so as to drain freely and so that it will not churn when soaked through rainfall. The proportion of sand must not be too large nor must there be an excess of pebbles, the proportion should be about three portions of sand and five portions of coarse pebbles. Everyone knows that these specifications are hard to fill and nature has not been too prolific in that respect. I can myself sing a little song of hunting and testing for gravel during several busy seasons, requiring valuable time, which was really needed elsewhere. I can sing several other songs of utter and nearly ruinous disappointment following the opening of certain gravel pits, which were said to have been thoroughly tested, and on the strength of such tests were bought at fancy prices, only to be found as composed of ¾ fine sand and ¼ fair and usable gravel. It cannot be denied that good track can be made with gravel ballast. Track in so far as ballast proper is concerned can be kept up somewhat cheaper than stone ballast, but being less porous than the latter will foul more speedily and will hasten decay of ties. Some have advocated the theory of washing gravel before putting same in as ballast. I do not know whether or not this has actually been tried and what results have been obtained, but if it acts (and there is no reason in the world why it should not so act) as a certain gravel in my experience which by nature had been washed and consisting of round and oblong pebbles with little or no sand, it certainly is a failure. The material referred to was hailed with delight when pit was opened, placed on the track with equal delight and ease, but alas, to this day the section men are exhausting their vocabulary to cuss it. When walking that track one must be careful not to step between the ties as he will surely lose his footing and it reminds me of that kind of stone that gathers no moss. Sand ballast is an expedient only and used when other material is unavailable or in case of a combination of such conditions and minor importance of track. It is objectional on account of the large amount of dust raised from it by passing trains, although excellent track can be produced by its use

and it goes without saying, the coarser the sand the better all around. The greatest objection, however, to sand ballast is through its being less porous than other ballast and therefore extremely inducive towards hastening decay of ties, and fouling very quickly.

Cinder Ballast.—I know a railroad manager who will not permit the use of cinders as ballast for either main or branch lines, and he does not even favor the use of same on passing or side tracks immediately adjoining main track. His exceptions are so-called "sink holes," and it is apparent that this manager's sense of beauty is somewhat too largely expanded and his ways, in my opinion, are rather radical. I know of one important western railway which has cinder ballast on several hundred miles on one of its most important main lines. Cinder ballast has been advocated as giving less resistance than any other and appears springy and therefor would make a good riding track. For reasons just stated, that of being springy, it is apparent that it requires much attention by track men. Frequent "picking up" and consequent renewal. It never gives the appearance of a first class track and is for that reason alone tabooed on the majority of first class lines, excepting of side tracks and industrial spurs.

Earth Ballast.—Track ballasted with earth is in trackman's language denoted as "mud track" and in justice to trackmen, I must say that it is well named. It is, of course, more of an expedient than sand and cinder ballast and is used for either very unimportant track, or where, by force of circumstances and through the absence of either gravel or sand or great distance from base of supply of broken stone, slag or other materials, the use of any of these materials is rather prohibitive. There is yet a good deal of earth ballasted track in this and other particularly western states. I know of many miles of such track, which is really good as long as it does not rain, but when Jupiter-Pluvius is abundant in his gifts, it means very poor track, indeed, slow time, and the commercial drummer has no trouble to find something to kick about. Maintenance of earth ballasted track is therefor quite expensive, and for reasons previously stated ties are eaten up rapidly. One big item of expense is the constant requirement during the summer months of the removal of weeds and any one acquainted with the rank growth of them on rich Iowa bottom lands where crops of them are being produced every year knows what that means.

Good Ties.—This item is important and far-reaching enough to constitute a subject of its own. The question of ties and where to get them in the future as well as of which material they should be made, is a problem, indeed. To adhere to my subject, however, good ties are certainly very essential to good track. All ties of soft as well as hard wood have doubled and trebled in price in a very few years and their economical use is therefore imperative. Knowing this, therefore, it requires good judgment on the part of section foremen and roadmasters, so as not to jeopardize the safety of track in a wrong conception of economy. It is interesting to note that the percentage of oak ties used today is by far the largest as compared with soft wood ties, such as cedar, hemlock, tamarack, etc., and is greater than it was some years ago, notwithstanding the fact that many more miles of railroad have been added since that time, and the total number of ties used thereby enormously increased. Experiments have been made and are constantly being made in an effort to find a substitute for wooden ties, the supply of which if not added to will sooner or later be entirely exhausted. While some progress has been made and some experiments are proving more or less successful in the direction of finding a substitute for the wood tie, I am justified in stating that as yet no such satisfactory substitute has been found. Experiments are directed and confined to steel and concrete. The main obstacle has so far been found in the extreme rigidity and utter lack of pliancy of these materials. Efforts are being made to overcome this by inserting a block of wood immediately under the rails and thereby reverting more or less to the principle of wood ties. The only salvation for railroads seems to lie in the fact of providing for a future supply of wooden ties through the planting of trees and from various reports at hand it is gratifying to note that many railway companies are starting in that direction.

Rails and Fastenings.—This is also a subject deserving treatment by itself, and I will only briefly remark that while good rails are highly essential for good track and such fact is realized by the railroads, it is also a fact that of late our mills have turned out a very inferior article. The concerted action of technical societies and the American Railway Association will undoubtedly shortly revolutionize the rail making process and it is hoped that better results will be obtained. Present day requirements through heavy rolling stock are in the direction of heavy rail, generally from 80 pounds to 100 pounds per yard. With good material in same equally good track will be assured. Fastenings of today are very much of a variety and the old style fish plates have seen their day while the cast chair is now a curiosity. Efforts, of course, are towards securing a rigid joint and there is just a little danger of overdoing this by creating such rigidity of joints as to overshadow the rail proper. A great many patterns of rail joints are on the market, a great many of them very good and some less so. They all are, in the opinion of the respective manufacturer, good, and as we know that all manufacturers of those and other railroad supplies are in the business, not for personal gain, but as public bene-

factors, we will believe them in the interest of good track.

Good Men.—When the young Edwin Booth set out in his dramatic career, he approached an old actor with this question: "What must I do to play Hamlet?" The old man replied: "Instead of trying to play Hamlet, you had better learn a trade." "But," said the young Booth, "I wish to play Hamlet, I must play Hamlet, and I will play Hamlet." The old man, with the fire of enthusiasm in his eye, said: "Well, if you put it that way, if you want to play Hamlet, you must read Hamlet, you must eat Hamlet, you must drink Hamlet, and by the gods you must be Hamlet."

I have often said to young men coming fresh from college and wishing to be a trackman and roadmaster: "If you want to be a trackman, you must read track, eat track, drink track, and by the gods you must be a trackman."

In demanding that good men are required to make good track we must necessarily principally refer to those in charge of maintenance of track—the roadmaster and section foreman. The American Roadmaster or Supervisor of Track, as he is sometimes called, is a type distinctly of his own. Whether he is one with college training or has arisen from the ranks, in all cases he must be a good general, and above all a good trackman. Unlike his brother on the European continent, he has a comparatively large district under his charge and is always a busy man. Every wreck, every washout and every mishap of any other kind demands his personal attention. It has become a serious problem of late to find timber for section foremen, and this is at present one of the greatest hardships which the roadmaster has to deal with. By far the greatest amount of track laborers today are of the element of foreigners, who mainly, by reason of inferior intelligence, offer no suitable timber for promotion, and it takes considerable discretion and ability of the foreman in dealing with that class of labor to accomplish what he is expected to do and keep his track in good condition. When we are speaking therefore of good men being required for good track, we are facing one of the greatest problems of the railroad world, one for which prosperous times are responsible only. Railroads have seen fit to consider track work inferior to any other labor in the industrial field as shown through their unwillingness of placing track labor on the same level with other labor as regards compensation, and as a result the intelligent and promising portion of track labor has sought and found other fields.

Structural Features of Roundhouse

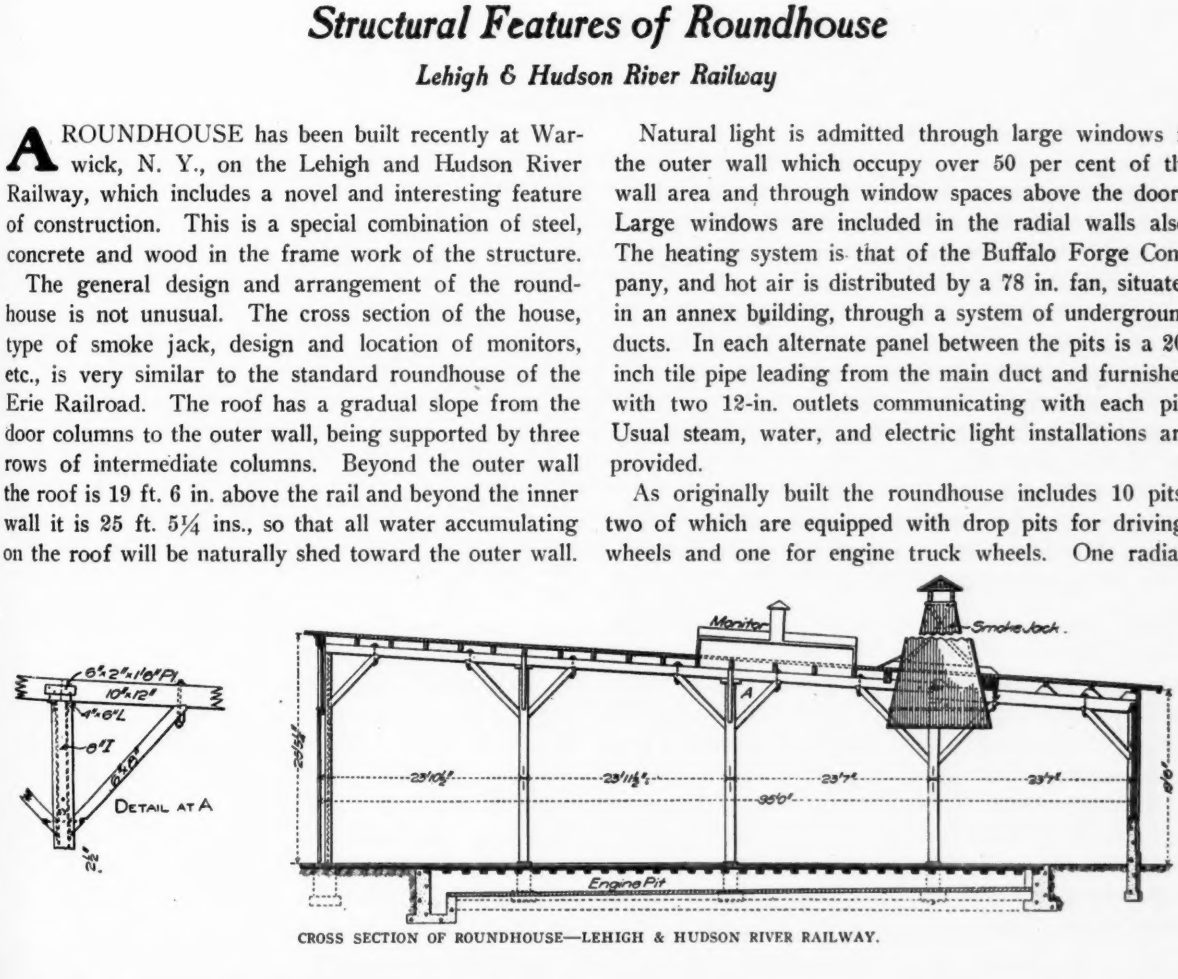
Lehigh & Hudson River Railway

A ROUNDHOUSE has been built recently at Warwick, N. Y., on the Lehigh and Hudson River Railway, which includes a novel and interesting feature of construction. This is a special combination of steel, concrete and wood in the frame work of the structure.

The general design and arrangement of the roundhouse is not unusual. The cross section of the house, type of smoke jack, design and location of monitors, etc., is very similar to the standard roundhouse of the Erie Railroad. The roof has a gradual slope from the door columns to the outer wall, being supported by three rows of intermediate columns. Beyond the outer wall the roof is 19 ft. 6 in. above the rail and beyond the inner wall it is 25 ft. 5¼ ins., so that all water accumulating on the roof will be naturally shed toward the outer wall.

Natural light is admitted through large windows in the outer wall which occupy over 50 per cent of the wall area and through window spaces above the doors. Large windows are included in the radial walls also. The heating system is that of the Buffalo Forge Company, and hot air is distributed by a 78 in. fan, situated in an annex building, through a system of underground ducts. In each alternate panel between the pits is a 20-inch tile pipe leading from the main duct and furnished with two 12-in. outlets communicating with each pit. Usual steam, water, and electric light installations are provided.

As originally built the roundhouse includes 10 pits, two of which are equipped with drop pits for driving wheels and one for engine truck wheels. One radial



CROSS SECTION OF ROUNDHOUSE—LEHIGH & HUDSON RIVER RAILWAY.

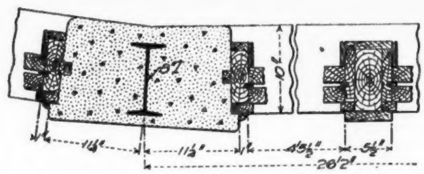
wall is of wooden construction and may be removed quickly when future extension is required. The span from outer face of outer wall to center line of door posts is 95 ft. and the distance from center line of door posts to center of table is 105 ft. 11 ins. The tracks are arranged on an angle of 7 degrees 28 minutes and the house is served by an 80-ft. turntable.

The novel feature of the roundhouse is the construction of the columns and the method of connection with wooden framework of the roof. Each column is made up of an 8-in. I beam enclosed in a solid rectangular mass of concrete with round corners in which is embedded a reinforcement of four ½ in. round rods hooped with wire. Pairs of horizontal cap and base angles are riveted to the web and flanges of the I beam. The columns have concrete foundation piers carried down to a depth of about 4 ft., the columns in the outer wall being seated on the continuous footing of the wall. The columns are knee braced in four directions to the wooden rafters and purlins with 6 by 8-in. struts, having both ends beveled and secured by tie bolts. The lower end engages an angle iron seat riveted to the I beam in the column and the upper end is toed into the rafter.

The rafters are 10 by 12-in. and have butt joints on the center lines of the columns to which they are secured with lag screws through the cap angles. The rafters are spliced with 6 by 2-in. fish plates and carry 4 by 12-in. purlins, about 4 ft. apart, making butt joints on their center line. The purlins are covered with 2 by 6-in. boards, water-proofed with asbestos roofing, laid by the Franklin Manufacturing Company.

The temporary radial wall is made with a framework of 4 by 6-in. vertical wooden studs, about 30 ins. apart, on centers, secured at the feet to a 4 by 10-in. sill, bolted to a concrete footing wall and covered with ordinary sheathing plank and siding. The permanent radial wall is of expanded metal-concrete construction 2½ ins. thick on structural metal frame. All the metal is encased in concrete so as not to be affected by smoke and gas. All of the other walls are of solid concrete 10 ins. thick above the water table and are made without reinforcement. Below the water table, which is 15 ins. above the top of rail, the thickness of the wall is 12 ins., down to the concrete footing. This is 20 ins. wide and 12 ins. deep, with its upper surface 3 ft. below the top of rail.

The door openings are 12 ft. 4 ins. wide and 17 ft. high. The doors are of usual wooden construction, swung on hinges, bolted to the columns. The interior of the smoke jacks are painted with "Muralo" fireproof paint and thoroughly sanded. All other interior wood work, except window frames, is painted with fireproof paint. All exterior wood work and window frames inside are given three coats of Chilton dark green paint, trimmed with Indian red, the successive coats differing slightly in color. All concrete surfaces are left natural and unpainted.



WALL COLUMN AND PIER-ROUNDHOUSE OF LEHIGH & HUDSON RIVER RAILWAY.

The building was designed and specified by Mr. Mason R. Strong, consulting engineer, New York City, and the general contract was executed by Welch Brothers, Warwick, N. Y. All foundation and pit work to the floor line was done by the railway company's forces under the supervision of Mr. J. E. Barrett, superintendent of tracks, bridges and buildings.

Railway Bulletins

Bulletins have been sent out by the American Railway Engineering and Maintenance of Way Association to be examined in advance of the annual meeting to be held at the Auditorium Hotel, Chicago, on March 17, 18 and 19, 1908. These bulletins contain the committee reports and afford an opportunity for the members to prepare discussions to be presented at the meeting.

It is urged by the committee on publications that members preserve the copies for their use and bring them to the convention, as their is no adequate supply of extra copies.

Passenger Rates

In November, 1906, the Italian Government put into effect a schedule of passenger rates, which materially lowered fares throughout the country, particularly for the longer distances. Second-class fares in general are 2 cents per mile, with reductions of from 10 to 25 per cent on round-trip tickets. First-class fares, representing what in the United States would be ordinary trains, are, as a rule, about 5 per cent more than the second class, and the third class about 5 per cent less than the second class. Second-class accommodations on the express trains are practically the same as in the first class, but the distinction is maintained for the benefit of foreign travelers. Under a special system of "circular tickets" passenger fares have been further reduced on the state lines. For instance, by the old schedule, a round-trip ticket from Milan to Turin, Genoa, Bologna and Ancona, 1,160 miles, cost $25.75, while under the new schedule the cost is only $17.65. A still further reduction, in some cases as much as 75 per cent from the regular rates, is made in circular tickets, bearing a photograph of the holder, and entitling him to travel at will during its time limit. This reduction is highly useful to commercial travelers, etc. (Consul Dunning's complete report, and a railroad map of Italy, are on file in the Bureau of Manufactures.)

Tie Plates and Spikes for Soft Woods

A FEW paragraphs from a circular of the Forest Service, U. S. Department of Agriculture, relate to mechanical wear and tear of soft wood ties. These paragraphs are given below and contain a suggestion as to the type of tie plate best adapted to service with soft wood ties.

It should be borne in mind that the impregnation of timber with antiseptics is a protective measure merely against decay and not at all against the mechanical abrasion to which the ties are subjected by the cutting and grinding action of the rails and spikes. Before it can be said that a certain method of chemical treatment will prolong the life of a tie for so many years, it must be granted that the tie will be so protected from abrasion as to prevent its mechanical destruction before the full value of the treatment has been realized. There are many devices for securing this protection, of which the simplest are tie-plates and screw-spikes. Both of these have been fully discussed in previous publications of the Forest Service.

TIE-PLATES.—Numerous forms of tie-plates are used in this country, many having been employed for several years on ties of oak and other hardwoods. With the substitution of treated ties of softer woods the same types of plates were used, but it was found that they afforded little protection and in many cases the ties so equipped were destroyed more rapidly than where no such device was used. An investigation showed that in every case the destruction was caused by projections from the under surface of the plates, such as spines or flanges. When used in hardwoods the spines become firmly embedded in the tough fibers of the wood and the plates thus give excellent service, but the fibers of the softer woods are too weak to resist the pulling action of the rails. The spines become loosened from the ties and by the constant motion of passing trains they grind the fiber and actually assist in the destruction of the tie. Water collects in the holes under the plates, the antiseptic salts in the treated ties are leached out, and the development of wood-destroying fungi is promoted. For these and other reasons more fully discussed in the publications referred to above, it is recommended that the spiked tie-plates now used by the Chicago & Northwestern Railway should be abandoned, with the substitution of some form better adapted to the demands of the ties in use.

SPIKES.—Second in importance only to rail cutting is the mechanical injury resulting from the form of spike generally used by the railroads in the United States. Even in the case of hardwoods much injury results from the tearing action of this type of spike, but the deterioration is hastened in soft wood ties which allow the spike to loosen much more readily. This not only necessitates frequent redriving, but permits the abrasion of the fibers under the base of the rail. The destruction is increased in the case of treated ties in which any abrasion of the treated surface exposes the unprotected wood to fungous attack.

In the experimental track it is proposed to test tie-plates of various patterns. These will consist of metal and of creosoted wood. In all cases in which wooden tie-plates are used screw-spikes will be employed for fastening the rail to the tie, and with the metal plates both screw-spikes and ordinary spikes will be used.

The experimental track should be maintained permanently for testing representative ties treated by different processes and by variations of the same process and further for determining the practical value of any device to promote the economical maintenance of the roadbed.

Railroad Earnings

Some idea of the importance of the net earnings of the railroads to a large number of people may be gathered from figures, now compiled to January 1, 1908, showing that on that date the shareholders in the Pennsylvania Railroad Company numbered 57,226—an increase of 16,370 for the year 1907. During the year the average holding decreased from 150 to 110 shares. The number of women stockholders increased from 19,282 to 26,471, while the number of European investors in the stock grew from 7,753 on December 31, 1906, to 9,149 one year later. The increase in total holders for the month of December, 1907, was 1,831.

Floating Concrete Blocks

Major W. V. Judson, the government engineer in charge of harbor work at Milwaukee, Wis., is experimenting with reinforced concrete blocks, made hollow, so that they can be floated to place in constructing the government breakwater at that point. The proposed block of standard size will weigh about 14 tons, but in the experiments the weight is only about seven tons. The blocks will consist of reinforced concrete walls enclosing a hollow space. After it has been towed to the site of the work an opening in the bottom is uncovered and water is permitted to enter the block and sink it. The interior of the block is then filled with sand and gravel and the open space in the top is filled with concrete.

Signal Installation

The Eastern Bengal State Railway has installed Barasat station (about 14 miles from Calcutta) with what is known as "one pipe all-pneumatic system of working signals and switches." The installation was subject to a severe test on Dec. 18, 1907, by Mr. G. K. Rogers, signal engineer, Mr. Jacomb Hood, representative of the British Pneumatic Company, and Mr. White, consulting engineer, in the presence of Mr. Bhola Singh, who had put up the installation. Great

credit is due to Mr. G. K. Rogers, for having taken so great an interest in bringing the installation to a successful issue, and also for having obtained the services of Mr. Bhola Singh on loan from the Bengal-Nagpur Railway. Mr. Bhola Singh, we understand, has been connected with that railway for a considerable length of time, and is an expert in interlocking works, specially of the type of the system on which he has been deputed for Barasat. A detailed report is under preparation and will be out shortly. It would not be out of place to mention that this is the first installation (purely pneumatic) of its kind in India.—Indian Engineering.

Life of Ties

With nearly 300,000 miles of railroad trackage and approximately 2.800 ties to the mile, there are over 800,000,000 ties constantly subject to wear and decay. The railroads report that in the form of ties cedar lasts eleven years, cypress ten years, and redwood nine years. These woods, however, lack the desired weight and hardness, and, what is more important, they are not available in the region of the trunk lines of the Central and Eastern States. When it is considered, then, that the service of the longest-lived tie timbers in general use—chestnut, white oak, tamarack, spruce, and Douglas fir—is but seven years, while with some, as the black oaks, it is but four years, whereas a treated tie with equipment to lessen wear will last fifteen years, it is apparent how much the railroads can save if preservative treatment of ties is universally adopted. The saving in the drain upon the forests is of even greater moment.

Prices on Track Materials, F. O. B. Chicago

TRACK SUPPLIES.

Steel Rail, 60 lbs. and over	$28.00 per gross ton
Steel Rail, 25 to 45 lbs	28.00 per gross ton
Steel Rail, 20 lbs.	29.00 per gross ton
Steel Rail, 16 lbs.	30.00 per gross ton
Steel Rail, 12 lbs.	31.00 per gross ton
Ties, 6x8x8 oak, 1st grade	74c each
Ties, 6x8x8 oak, 2d grade	67c each
Switch Ties	$27.00 to $28.00 M. ft.

Angle bars, accompanying rail orders, 1908 delivery, 1.65c.; car lots, 1.75c. to 1.85c.; spikes, 1.90 to 2.00c., according to delivery; track bolts, 2.40c. to 2.50c., base, square nuts, and 2.55c to 2.65c., base, hexagon nuts. The store prices on track supplies range from 0.15c. to 0.20c. above mill prices. Switch set per turn out, 85-lb. rail, $100 to $105.

OLD MATERIAL.

Old Steel Rails, rerolling	$13.00 to $13.50
Old Steel Rails, less than 3 ft.	13.00 to 13.50
Old Iron Rails	17.00 to 17.50

SHEET STEEL.

It is quoted for future delivery:

Tank plate ¼-in. and heavier, wider than 6¼ and up to 100 in. wide, inclusive, car lots, Chicago, 1.88c. to 2.08c; 3-16 in., 1.98c. to 2.18c.; Nos. 7 and 8 gauge, 2.03c. to 2.23c.; No. 9, 2.13c. to 2.33c. Flange quality, in widths up to 100 in., 1.98c. to 2.08c., base for ¼-in. and heavier, with the same advance for lighter weights; Sketch Plates, Tank quality, 1.98c. to 2.18c.; Flange quality, 2.08c. Store prices on Plates are as follows: Tank Plate, ¼-in. and heavier, up to 72-in. wide, 2.10c. to 2.20c; from 72 to 96 in. wide, 2.20c. to 2.30c.; 3-16 in. up to 60 in. wide, 2.20c. to 2.35c.; 72 in. wide, 2.40c. to 2.50c.; No. 8 up to 60 in. wide, 2.20c. to 2.25c.; Flange and Head quality, 0.25c. extra.

STRUCTURAL STEEL SHAPES.

Store quotations are unchanged at 2.05c. to 2.10c., and mill prices are as follows: Beams and Channels, 3 to 15 in., inclusive, 1.88c.; Angles, 3 to 6 in., ¼-in. and heavier, 1.88c.; larger than 6 in. on one or both legs, 1.98c.; Beams, larger than 15 in., 1.98c.; Zees, 3 in. and over, 1.88c.; Tees, 3 in. and over, 1.93c., in addition to the usual extras.

CAST IRON PIPE.

Quotations per net ton on Water Pipe, 4 in., $30; 6 to 12 in., $29; over 16 in., $28; with $1 per ton extra for gas pipe.

CEMENT.

Good grade Portland Cement, car lots...$1.65 per bbl.*

* (Four sacks per bbl. credited 10c each when returned in good condition.)

SAND.

Bank sand, car lot	$0.75 per yd.
Torpedo sand, car lot	1.15 per yd.

CRUSHED STONE GRAVEL.

Crushed limestone, car lot	$1.05 per yd.
Crushed gravel, car lot	1.00 per yd.

Personals

Mr. E. B. Brown, foreman of bridges and buildings of the St. Louis & San Francisco, at Cape Girardeau, Mo., has been transferred to Beaumont, Tex., in a similar capacity, succeeding Mr. H. M. Henson, resigned.

Mr. Joseph Kelly has been appointed roadmaster of the Pacific & Eastern at Medford, Ore.

Mr. P. W. Sayre, general foreman of bridges and buildings of the Atchison, Topeka & Santa Fe at Topeka, Kan., has been retired under the pension rules of that system.

Mr. E. J. Correll has been appointed division engineer of the Valley division of the St. Louis, Iron Mountain & Southern at Monroe, La., succeeding Mr. R. A. Gray, resigned.

Mr. F. B. Walker, resident engineer of the Great Northern at Superior, Wis., has been appointed resident engineer at St. Paul, Minn., succeeding Mr. A. Jackson, resigned.

Mr. H. F. White has resigned as engineer of maintenance of the Chicago, Rock Island & Pacific at Chicago, and the office is abolished.

Mr. R. P. Black, division engineer of the Toledo & Ohio Central, has been appointed division engineer of the Kanawha & Michigan at Charleston, W. Va.

Mr. E. S. Heyser has been appointed roadmaster on the St. Louis, Brownsville & Mexico Railway, with jurisdiction from Robstown to Algoa, vice Mr. H. A. Lones, assigned to other duties. Mr. Heyser's headquarters are at Kingsville, Tex., to which point all time books, communications, etc., should be addressed.

The office of assistant to engineer of maintenance of the Rock Island Lines having been abolished, Mr. C. F. Ford has been appointed supervisor of tie supply, charged with the distribution and inspection of ties and with the handling of rail supply, reporting to the general manager.

Mr. C. S. Weston, division superintendent of the Chicago Great Western at Red Wing, Minn., has been appointed superintendent of the southwest division, with office at Des Moines, Ia., succeeding Mr. C. L. Nichols, resigned. Mr. C. T. Banks, heretofore freight claim agent, has been appointed division superintendent at Red Wing in place of Mr. Weston

Mr. E. P. Weatherly has been appointed chief signal maintainer of the Texas & Pacific, with headquarters at Ft. Worth, Tex.

Cast Iron Culvert Pipe

The American Casting Company, Birmingham, Ala., is putting on the market a light weight, short length, large diameter cast iron culvert drain and sewer pipe. This pipe is made in 3-foot lengths with 16, 20, 24, 30, 36 and 48-inch diameters and is designed expressly for the purposes named above. One object in view is to replace the heavy pipe of 12-foot lengths which is now used. This 12-foot pipe is made to stand internal pressure and is, therefore, unnecessarily heavy for culvert, drain or sewer requirements.

The dimensions and weights of the pipe that is furnished are as follows:

	Thickness of pipe, T.	Face of hub, F.	Weight, per ft.
Diameter of pipe, 12-inch....	7/16-in.	9/16-in.	60 lbs.
" " " 14-inch....	7/16 "	9/16 "	70 "
" " " 16-inch....	1/2 "	5/8 "	90 "
" " " 18-inch....	1/2 "	5/8 "	105 "
" " " 20-inch....	1/2 "	5/8 "	120 "
" " " 24-inch....	9/16 "	11/16 "	160 "
" " " 30-inch....	5/8 "	3/4 "	220 "
" " " 36-inch....	11/16 "	13/16 "	300 "
" " " 42-inch....	3/4 "	7/8 "	380 "
" " " 48-inch....	13/16 "	15/16 "	460 "

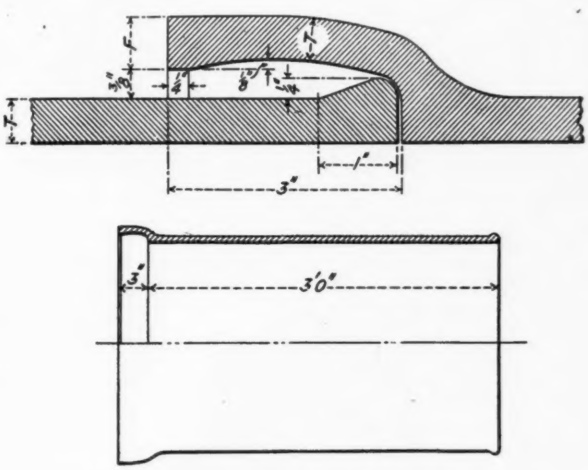
The short length pipe is easily handled and rolled into place by one man and obviates the use of crane, giving besides a flexible pipe with 4 bell and spigot joints to a 12-foot run. The design of the bell and spigot is that adopted by the Union Pacific Railroad and admits of either cement or lead joints.

Many railroad and city engineers, contractors and supervisors are very friendly to this product, as it saves them in cost per foot on account of the pipe being from 30 to 38 per cent lighter per foot than the standard water pipe. Longitudinal sections of pipe and joint are shown in the accompanying drawing.

Car Replacers

The Washburn Steel Castings & Coupler Company, Minneapolis, Minn., has put on the market a car replacer which is said to do the work more easily and quickly than any wrecking frog now in use. The weight of a pair of replacers is only a little over 200 pounds.

It is not necessary to get down on the tracks during the winter weather and dig the snow out from under the rails. All that



CAST IRON CULVERT PIPE AND DETAIL OF BELL AND SPIGOT.

is necessary is to place the replacer on the tie, give the signal to go ahead and then take the car replacer out.

While the replacer is a little heavy, it is not inconvenient to handle and does the work in about 60 seconds. It is getting the reputation of being the good old reliable for this class of work.

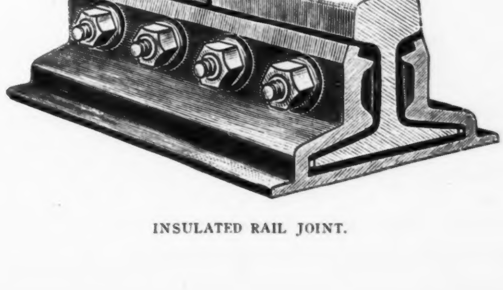
Insulated Rail Joint

William F. Bossert, of Utica, N. Y., is manufacturing an insulated rail joint, which is recommended for its efficient insulation, durability and low cost of maintenance.

The joint, shown herewith, is made of one piece of steel, which allows of a large even surface for heavy insulation the full width of rail-base. Heavy pieces of insulation of special shape are furnished for the underside of rail-tread. Owing to the limited surface of the underside of rail-tread and the severe wear that this part of the insulation is subjected to, provision is made whereby these parts can be removed, if necessary, without the removal of a bolt or spike.

To place the joint in track, the fibre end post between rails is inserted first, the fibre under base of rail next, then the fibre on top of flange and side of web, and last the fibre pieces under rail-head.

The sides of joint are susceptible of considerable spring,



INSULATED RAIL JOINT.

which is taken up by the bolts. This allows easy insertion of insulation by loosening bolts, serves to take up wear of insulation by tightening bolts and prevents bolts from working loose.

The joint has been in service on the New York Central & Hudson River Railroad since 1905 and is said to be in good condition at the present time.

New Switch Indicator

The General Electric Company has recently placed on the market a new switch indicator, which embodies the good features of the earlier forms and provides against troubles that have been encountered in other designs. Reliability and economy of current were objective points of the design.

When the indicator is in the clear position, a resistance, amounting to double that of the operating coils, is thrown in series with them, reducing the current consumption by two-thirds. With the indicator at danger, this resistance is cut out by a back contact. This arrangement, while securing a strong and positive pull in the clear position, introduces a great economy in current consumption. The release is positive.

NEW SWITCH INDICATOR.

The case is absolutely weatherproof, being provided with an elastic felt door gasket; and it overhangs the mechanism in such a way as to afford the greatest possible protection when it is necessary to open the door in stormy weather. The wires enter at the bottom through an insect barrier of elastic felt, and the dial is so designed that it is impossible for spiders or other insects to secure access to the blade. The terminals are arranged on a special non-warping insulation compound. The magnets are wound with enameled waterproof wire and the resistance tubes are of substantial construction. Armature and shaft bearings are cylindrical and of hard-drawn German silver. The cores are of the highest grade of Norway iron re-annealed by a special process. All parts of the mechanism are carefully and accurately constructed. Provision is made inside of the case for the attachment of a two-point General Electric lightning arrester, which is furnished when desired.

Trade Notes

The Joseph Dixon Crucible Company, Jersey City, N. J., has recently issued a booklet entitled "Air Brake Lubrication," which is attractive in appearance and valuable as to information. It contains a description of the properties, uses and special advantages of Dixon's Ticonderoga Graphite Air Brake and Triple Valve Grease, and Dixon's Special Graphite No. 635. The conclusions of a long series of tests by Prof. W. F. M. Goss are also given.

Quincy-Manchester-Sargent Company has removed its general offices from 90 West street, New York, to its factory at Plainfield.

Conley Frog & Switch Company, Memphis, Tenn., at the annual meeting of the board of directors held in Memphis on February 3 elected the following officers: J. E. Conley, president; B. L. Mallory, vice-president; and Frank J. Callahan, secretary and treasurer.

Chirago Railway Equipment Company has moved into its new plant at Winchester avenue and Forty-sixth street, Chicago.

W. K. Kenly Company, Chicago, has added an equipment department to its business and is now operating it, in conjunction with the established line of rails and track materials. The company reports a well-assorted list of rebuilt engines and cars on hand for prompt shipment.

J. F. Donahue, for five years secretary and manager of sales of the New Castle Forge & Bolt Company, has severed his connection with that concern to become western sales manager for the Russell, Burdsall & Ward Bolt & Nut Company of Port Chester, N. Y. Mr. Donahue's headquarters will be in the Commercial National Bank building, Chicago.

Standard Paint Company, New York, has removed its office from Atlanta, Ga., to 506 Hibernian Bank building, New Orleans, La.

Technical Publications

TESTS ON PLAIN AND REINFORCED CONCRETE, by Morton Owen Withey, C. E, Bulletin No. 175, published by the University of Wisconsin, Madison, Wis. Paper binding, 66 pages, 6x9 inches. Price, $0.25.

The subjects, investigated in the bulletin, are given as follows: Bond; compressive strength of concrete in cubes, cylinders and beams; effect of compression reinforcement in beams; overhanging beams; diagonal tension failures and methods of preventing the same, and tee beams.

Practical working conditions were considered in the mixing of concrete, construction of beams, testing of beams, etc., and for this reason the data may be applied in design. The data includes also the factor of reliability.

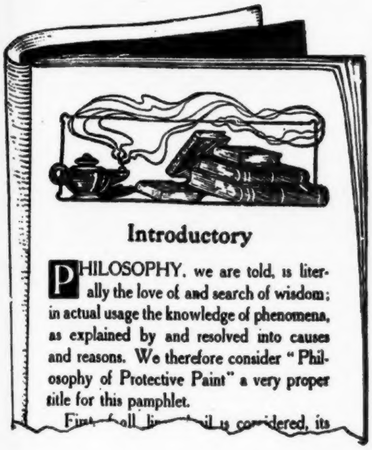
A STUDY OF ROOF TRUSSES, by N. Clifford Ricker, D. Arch., Professor of Architecture. Published by University of Illinois—Engineering Experiment Station, Urbana, Ill. Paper binding, 28 pages, 6x9 inches.

The pamphlet, entitled "A Study of Roof Trusses," is Bulletin No. 16 of the series of publications by the Engineering Experiment Station. The original object of the investigation, described in the bulletin, was the determination of a formula for the weight of roof trusses.

The summary of results gives an idea as to the data which it contains. It is as follows:

(a) Comparison of formulas for normal wind pressure.
(b) System of calculation and design.
(c) Form of stress sheet.
(d) Formula for weight of truss.
(e) Comparative weights of trusses of other materials.
(f) Economical distance between trusses.
(g) Economical length of panels.
(h) Economical number of purlins per panel.
(i) No advantage results from cambering lower chord.
(j) Economical ratio of rise to span of roof trusses.

It is thought that the bulletin will be of value to architects and engineers. Data is presented in form convenient for comparison and therefore saves time and labor in calculating and designing roof trusses. Copies of the bulletin ore furnished gratis by the Director, Engineering Experiment Station, University of Illinois.



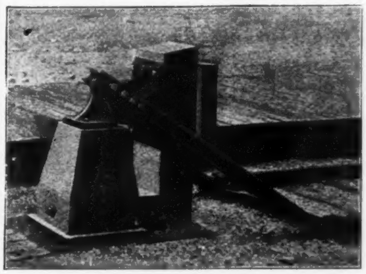
If you want the complete story of the Philosophy of Protective Paint just write us (a postal will do) asking for free copy.

B-187

This treatise was written by the superintendent of a large paint works, who, in addition to a technical training has had years of practical experience in making our testing paint.

It will be more than worth your while to get the "whole story."

JOSEPH DIXON CRUCIBLE CO.
JERSEY CITY, N. J.

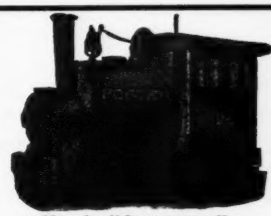


ELLIS PATENT BUMPING POST

Noted for Simplicity, Strength and Lasting Qualities. Adapted to all positions.

Mechanical Mfg. Co.,
CHICAGO, ILL.


No. 68. "Steel Works."


No. 26. "Contractors."

The Engineering Department

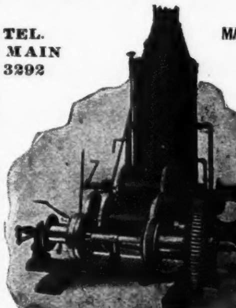
of Every Large Railroad and Every Railroad Contractor should have a copy of our Illustrated Catalogue with 200 pages of Useful Information not elsewhere printed. Address:

H. K. PORTER COMPANY, CORNER SIXTH AND WOOD PITTSBURGH, PA.
Contractors' Locomotives on Hand in Stock

H. J. McKEOWN

TEL. MAIN 3292

MANUFACTURERS OF



Contractors Plant, Stone Hoisting and Pile Driving Engines

Crabs and Derrick Irons a Specialty

Jobbing Promptly Attended to

612 E. FRONT ST., BET. PIKE AND BUTLER
CINCINNATI, OHIO

FOR SALE CHEAP!

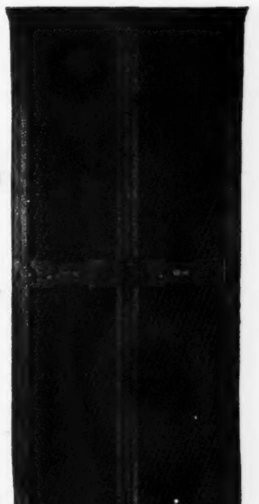
One 100 H. P. Morrison Corrugated Furnace Scotch Marine Boiler, 78 in. x 13 ft. 6 in. One 12x16 double cylinder, double drum Ligerwood Heavy Duty Hoisting Engine. Both in excellent condition.

Address, **C. N. HARPER,**
United States Express Co's. Bldg., Chicago

LOCKERS

MADE BY US

of Expanded Metal or Sheet Steel Insure a Positive Security and have Points of Superiority over all others.



We also make Metal Shelving, Screens and Inclosures

Write for Catalogue

MERRITT & CO.
1124 Ridge Av., PHILADELPHIA

RAILWAY ENGINEERING

BOOK-SELLING DEPARTMENT

Any of the following books will be sent by mail, postage paid, upon receipt of the price. When ordering more than one copy state whether to be sent by express. Cash should be sent with order. Remit by postal or express money order or by bank draft on Chicago or New York.

RAILWAY ENGINEERING.

510 Security Building
CHICAGO, ILL.

TRACK AND ROADBED LOCATION, MAINTENANCE AND CONSTRUCTION.

- Street Railway Roadbed by Mason D. Pratt and C. A. Alden .... $ 2.00
- The Railroad Spiral by Wm. H. Searles 1.50
- Notes on Electric Railway Economics and Preliminary Engineering by W. C. Gotshall 2.00
- The Transition Curve by C. L. Crandall 1.50
- Handbook for Street Railroad Location by John P. Brooks. 1.50
- Standard Turnouts on American Railroads by F. A. Smith 1.00
- Railway Locations in Victoria, Australia, by D. M. Fraser.. .25
- Maintenance of Way Standards by 1.50
- Engineering Preliminaries for an Interurban Electric Railway by Ernest Gonzenbach.. 1.00
- Practical Switch Work by D. H. Lovell 1.00
- The Economic Theory of the Location of Railways by Arthur M. Wellington 5.00
- Railroad Construction by Walter Loring Webb............ 5.00
- Field Practice of Railway Location by Willard Beahan.... 3.00
- The Field Practice of Laying out Circular Curves for Railroads by J. C. Trautwine.... 2.50
- The Trackman's Helper by J. Kindelan 1.50
- Railway Right of Way Surveying by Albert I. Frye...... 1.00
- Economics of Road Construction by H. P. Gillete......... 1.00
- Railway Surveys and Resurveys by H. Paul................. 1.00
- Surveying Manual; A Manual of Field and Office Methods by Pence and Ketchum...... 2.00
- The Railway Transition Spiral by Prof. A. N. Talbot........ 1.50
- Topographical Record and Sketch Book for Use with Transit and Stadia by D. L. Turner .... .75
- Railway Track and Track Work by E. E. R. Tratman... 3.00
- Road Making and Maintenance by C. Herschel and E. P. North .... .50
- Maintenance of Way Standards on American Railways by F. A. Smith 2.50
- Rules for Railway Location and Construction of the Northern Pacific Railway Co. by E. H. McHenry 1.00
- Notes on Track by W. M. Camp 3.75
- Construction American Railway, Development, Management, and Appliances 3.00
- A Manual of Land Surveying by F. Hodgman 2.50
- Specifications for Track Laying by W. Katte .... .10
- Railroad Location Surveys and Estimates by F. Laves....... 3.00

BRIDGES, BUILDINGS, STRUCTURAL WORK.

- American Railway Bridges and Buildings by Walter G. Berg.. 2.50
- Specifications for Steel Bridges by J. A. L. Waddell........ 1.25
- Bridge and Structural Design by Thomas W. Chase........
- Properties of Steel Sections by John C. Sample............. 3.00
- The Design of Simple Roof-Trusses in Wood and Steel by Malverd A. Howe 2.00
- The Fireproofing of Steel Buildings by Joseph K. Frietag... 2.50
- The Designing of Draw-Spans by Charles H. Wright....... 3.50
- Buildings and Structures of American Railroads by W. G. Berg 5.00
- A Treatise on the Theory of the Construction of Bridges and Roofs by Prof. De Volson Wood 2.00
- Compound Riveted Girders as Applied in Buildings by Wm. H. Birkmire 2.00
- The Planning and Construction of High Office-Buildings by Wm. H. Birkmire.......... 3.50
- A Course on the Stresses in Bridges and Roof Trusses, Arched Ribs, and Suspension Bridges by Wm. H. Burr.... 3.50
- American Railroad Bridges by Theodore Cooper 2.00
- The Design and Construction of Metallic Bridges by W. H. Burr 5.00
- A Treatise on Wooden Trestle Bridges by Wolcott C. Foster 5.00
- Practical Treatise on the Construction of Iron Highway Bridges by A. P. Boller...... 2.00
- Types and Details of Bridge Construction by F. W. Skinner. First vol. $3.00; second vol.... 4.00
- Tables for Roof Framing by G. D. Inskip 3.00
- Mathematical and Graphical Roof Framing by G. D. Inskip:
  - Vol. 1. Text, cloth, 160 p. 1.00
  - Vol. 2. Tables of Reduction and Squares from Zero to 150 feet by 8ths and to 120 feet by 10ths 1.00
- A Text-Book on Roofs and Bridges by Mansfield Merriman and Henry S. Jacoby:
  - Part 1. Stresses in Simple Trusses 2.50
  - Part 2. Graphic Statics 2.50
  - Part 3. Bridge Design 2.50
  - Part 4. Higher Structures .. 2.50
- The Design of Steel Mill Buildings and the Calculation of Stresses in Framed Structures by M. S. Ketchum 4.00
- General Specifications for High Roofs and Buildings by Chas. E. Fowler (paper)........... .25
- General Specifications for Highway Bridges by E. Thacher. .25
- Mill Building Construction by H. G. Tyrrell 1.00
- Graphics for Engineers. Architects, Builders by Chas. E. Greene:
  - Part 1. Roof Trusses 1.25
  - Part 3. Arches in Wood, Iron and Stone 2.50
- Tables and Diagrams for Calculating the Strength of Beams and Columns by Benj. E. Winslow 2.00
- Practical Treatise on Foundations by W. M. Patten...... 5.00
- Thames River Bridge by A. P. Boller 5.00
- Theory and Practice in the Designing of Modern Framed Structures by O. W. Bryan.. 10.00
- Graphic Method by Influence Lines for Bridge and Roof Computations by W. H. Burr 3.00
- Inspection of Materials and Workmanship Employed in Construction by A. T. Byrne. 3.00
- Ordinary Foundations, Including the Cofferdam Process for Piers, with numerous examples of Actual Work by C. E. Fowler 3.50
- Bridge Trusses by C. E. Greene 2.50
- Structural Mechanic by C. E. Greene 2.50
- Treatise on Arches by M. A. Howe E..................... 4.00
- Materials of Constructions by J. B. Johnson 6.00
- Permanent Fortifications by D. H. Mahan 7.50
- Strength of Materials by M. Merriman 1.00
- Graphic Statics with Applications to Trusses, Beams and Arches by J. Sondericker.... 2.00
- Pocket-book for Bridge Engineers: De Pontibus by J. A. Waddell 2.00
- Specifications for Steel Railroad Bridges and Structures by A. W. Buel .... .50
- General Specifications for Foundations and Substructures of Highway and Electric Railway Bridges by T. Cooper... 1.00
- Specifications for Steel Highway Bridges by T. Cooper....... .50
- General Specifications for Steel Roofs and Buildings by C. E. Fowler .... .25

BOOK DEPARTMENT (Continued)

EARTHWORK AND MASONRY AND ITS COST.

- Specifications for Grading and Masonry for Railway Beds by W. Katte .... .25
- Table of Cubic Yards by S. B. Fisher .... .25
- Retaining-Walls for Earth by Malverd A. Howe 1.25
- Earthwork and Its Cost by Halbert Powers Gillette 2.00
- A Treatise on Masonry Construction by Ira O. Baker 5.00
- A Method of Calculating the Cubic Contents of Excavations and Embankments by the Aid of Diagrams by J. C. Trautwine 2.00
- Prismoidal Formulae and Earthwork by Thomas U. Taylor 1.50
- Earth and Rock Excavation by C. Prelini 3.00
- Tables for Calculating the Cubic Contents of Excavations and Embankments by John R. Hudson 1.00
- Tunneling, Explosive Compounds, and Rock Drills by H. S. Drinker 25.00
- Rock Excavation by Halbert Powers Gillette 3.00
- Tunneling by C. Prelini, Additions by C. S. Hill 3.00
- Ordinary Foundations by Charles Evan Fowler ....
- Railway and Other Earthwork Tables by Charles L. Crandall 1.50
- Railroad Curves and Earthwork by C. F. Allen 2.00
- Modern Stone-Cutting and Masonry by J. S. Siebert 1.50
- Improvements of Rivers by B. F. Thomas 6.00
- Design and Construction of Dams by E. Wegmann 5.00
- Treatise on Roads and Pavements by I. O. Baker 5.00
- Highway Construction by A. T. Byrne 5.00
- City Roads and Pavements Suited to Cities of Moderate Size by W. P. Judson 2.00
- Earth Dams by Burr Bussell 1.00
- Earthwork Tables by H. S. Henderson 1.00

VENTILATION, HEATING, SEWERAGE.

- The Heating and Ventilation of Buildings by R. C. Carpenter 4.00
- Tables and Diagrams for Making Estimates for Sewerage Work by S. M. Swaab .... .50
- British Sewerage Works by M. N. Baker 2.00
- Ventilation and Heating by John S. Billings 4.00
- Electric Heating by E. J. Houston and A. E. Kennelly 1.00
- American Plumbing Practice by 2.50
- Cleaning and Sewerage of Cities by Prof. R. Baumeister 2.00
- Dimensions of Pipes, Fittings and Valves by W. D. Browning .... .75
- Steam Heating and Ventilation by William S. Monroe 2.00
- Sewerage Work Analyses by C. J. Fowler 2.00

ELECTRICITY, DYNAMOS, MOTORS.

- The Induction Motor by B. A. Behrend 1.50
- The Induction Motor; Its Theory and Design by Boy de la Tour 2.50
- Power Distribution for Electric Railways by Louis Bell 2.50
- Electric Power Transmission by Louis Bell 4.00
- Long Distance Electric Power Transmission by R. W. Hutchinson, Jr. ....
- Electricity One Hundred Years Ago and To-day by E. J. Houston 1.00
- Electric Transmission of Water Power by Alton D. Adams 3.00
- Electric-Dynamic Machinery by E. J. Houston and A. E. Kennelly 2.50
- High Tension Power Transmission by 3.00
- Berlin-Zossen Electric Railway Tests of 1903 by Louis Bell 3.00
- Recent Types of Dynamo-Electric Machinery by Edwin J. Houston and A. E. Kennelly 4.00
- Electrical Engineering Leaflets, Containing the Underlying Principles of Electricity and Magnetism by Edwin J. Houston and A. E. Kennelly. In three grades as follows:
  - Elementary Grade 1.50
  - Intermediate Grade 1.50
  - Advanced Grade 1.50
- Practical Calculation of Dynamo-Electric Machines by A. E. Wiener 3.00
- Original Papers on Dynamo-Machinery and Allied Subjects by John Hopkinson 1.00
- The Electric Motor by Edwin J. Houston and A. E. Kennelly 1.00
- Alternating Electric Currents by E. J. Houston and A. E. Kennelly 1.00
- The Theory and Calculation of Alterating Current Phenomena by Charles Proteus Steinmetz 4.00
- The Art of Illumination by Louis Bell 2.50
- Electric Arc Lighting by Edwin J. Houston and A. E. Kennelly 1.00
- Electric Lighting Specifications by E. A. Merrill 1.50
- Electric Incandescent Lighting by Edwin J. Houston and A. E. Kennelly 1.00
- Modern Electric Railway Motors by George T. Hancheft. 2.00
- The Universal Wiring Computer by Carl Hering 1.00
- Electricity and Magnetism by C. P. Steinmetz 2.50
- Shop and Road Testing of Dynamos and Motors by E. C. Parham and J. C. Shedd 2.50
- Spangenberg's Steam and Electrical Engineering by Messrs. E. Spangenberg, A. Uhl, and E. W. Pratt 3.50
- Storage-Battery Engineering by Lamar Lyndon 3.00
- Magnetism by Edwin J. Houston and A. E. Kennelly 1.00
- Alternating Current Wiring and Distribution by William Leroy Emmet 1.00
- Experiments with Alternate Currents of High Potential and High Frequency by Nikola Tesla 1.00
- Alternating Current Transformer by F. G. Baum 1.50
- Static Electricity by Hobart Mason 2.00
- Diagram of Electrical Connections by Cecile P. Poole 2.00
- Designs for Small Dynamos and Motors by Cecile P. Poole 2.00
- Dynamo Design; Its Theory and Practice by A. Press 2.00
- Lecture Notes on the Theory of Electrical Measurements by A. W. Anthony 1.00
- Practical Management of Dynamos and Motors by F. M. Crocker and S. S. Wheeler 1.00
- The Dynamo, Its Theory, Design and Manufacture by C. C. Hawkins and F. Wallis 3.00
- Alternating Currents and Alternating Machines by D. C. Jackson 3.50
- Transformers for Single and Multiphase Currents by G. Kapp 1.75
- Management of Dynamos by G. W. Paterson 1.50
- Electric Motor Construction for Amateurs by C. D. Parkhurst 1.00
- Electric Railway Motors by N. W. Perry 1.00
- Alternating Current Engineering Practically Treated by E. B. Raymond 2.50
- Alternating Current Machines by Sheldon and Mason 2.50
- Dynamo Electric Machinery by Samuel Sheldon 2.50
- Dynamos and Electric Motors Ed Trevert .... .50
- Electric Bells and All About Them by S. R. Bottone .... .75
- The Engineering and Electric Traction Pocket-book by Philip Dawson 5.00
- Electrical Engineers' Pocket-Book by Horatio Foster 5.00
- The Application of Electricity to Railway Working by W. E. Langdon 5.00

TELEPHONY AND TELEGRAPHY.

- Telephony by A. V. Abbott 6.00
  - Vol. 1. The Location of Central Offices 1.50
  - Vol. 2. The Construction of Underground Conduits 1.50
  - Vol. 3. The Cable Plant 1.50
  - Vol. 4. Construction of Aerial Lines 1.50
  - Vol. 5. The Substation 1.50
  - Vol. 6. Switchboards and the Central Office 1.50
- Wireless Telegraphy by A. Frederick Collins 3.00
- Electric Telegraphy by Edwin J. Houston and A. E. Kennelly 1.00
- American Telephone Practice by Kempster B. Miller 4.00
- Synchronous and Other Multiple Telegraphs by Albert Cushing Crehore 2.00

K

ks
ed
ite
me
e."

he
gs

NY
I, O.

CO.

nd
ps